MODIFICATION AND CALIBRATION OF DEFOLIATION EQUIPMENT

(C-123 - First Modification)

JULY 1962

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MODIFICATION AND CALIBRATION OF DEFOLIATION EQUIPMENT
(C-123 - First Modification),

A ~~joint report~~ by ~~personnel~~ of USDA, USAF
~~and USA CmlC of work performed~~ under OSD/
ARPA Order ~~256-62~~, [redacted]

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(Under Separate Cover)

I. BACKGROUND

The work r ported herein was assigned by OSD/ARPA (appendix A). It constitut s a joint effort of personnel of the Air Force, Department of Agricultur and the Army. The Ch mical Corps was designated Executive Agent.

The need or alibration was rep rted in references 1 and 2, was confirmed and ur her delineated in r ference 3 which inclu ed as well certain r commended modifications. Two discrete modifications are curr nt y ontemplated. The first odif cati n* was to provide as soon as possib a system capable of prod ing a flow rate sufficient to obta a posit f 1½ gallons per re, a partic le size mmd (mass median i m ter) approximat y 300 icrons and a swath width of approximately 500 eet. The s o d mo ification** was to provide the above ca abil ty except that its flow rate should be sufficient to provid a deposit of three ga lons per acre.

A e ommended approach prepared f r OSD/ARPA (appendix B) received verbal a rov l on 26 June 1962 with immediate emphasis on ex cuting Lin B i the tab lar presentation o ained therein.

Th p sent r port is concerned solely with the first modification of t e C-123/modified M-1 spray syst m. At h s time the availability of th ec nd mod fi at on for test ng canno be accurately pre i ted and may no be a ailable un il September or October, 1962.

The majority he data pres nted (esul s obtain d through 5 July 1962) h ve een used o provide adju tme t n rmation for the modifica-tion, such as nozzle p acemen , number and kinds of nozzles compatible with app op iate pressures for p oper nozz e performan e. These and other fact s have a irect in luenc n depo tion chara teristics.

Inheren in t e overall o ctives is he improveme t o aimability and effec i deposit of the ray wi h a min mization of drift, requ rement for riendly road de trea ment. Of course, th aimability is highe t e more direct y inwin th spray is released. Also, the con itions f inversion along w th u dire tional gentl wind prevailing from relea altit de t he g o nd and p allel ng a given road re requ re en s for the minimizat on of rif .

These o ition are believ d to e rel tiv ly rare and in our exp ience, intention lly se king these conditions during this work, have succeeded ss ntiall twice n m e tha 35 passes in obtaining excellent meteorolog c l condition with ut the estr c ion of having the wind paral e a ro d.

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* C-123 Aircra t Nu be 56-4362
** C-12 Aircraft Number 56-4386

For area coverage problems crosswind flights are usually sought, thus restrictions are not as numerous. Additionally, parallel equi-spaced spray flights are performed where the downwind "tail-off" of the spray contributes to previous spray deposits increasing the application rate.

During the course of the work personnel were indoctrinated in the methods employed. Subdivision of the work at Eglin AFB was as follows*:

<u>Flow Rate and Modification</u>

Mr. Donald Whittam, USDA. In charge.
Mr. Glenn Hipple, Olmstead AFB
Mr. Ken Baird, Olmstead AFB
and members of TAC, SASF as required

<u>Grid Operation</u>

Dr. J. W. Brown, CmlC. In charge thru 5 July 1962
Mr. L. W. Boyer, CmlC. In charge from 6 July 1962
Mr. R. Anders, CmlC.
Mr. C. Boyles, CmlC.
2nd Lt. C. Quibell,** CmlC. (thru 30 June 1962)
2nd Lt. C. Francis,** CmlC. (from 4 July 1962)
and CmlC enlisted personnel from Fort McClellan
Capt. R. W. Weaver, Eglin AFB
2nd Lt. V. L. Hazen, Eglin AFB

<u>Data Processing</u>

Mr. W. B. Johnson, CmlC, In charge

<u>Spray Flights</u>

Capt. E. H. Carlson, USAF, TAC, Langley AFB. In charge thru 1 July 1962
Capt. W. F. Robinson, Jr., USAF, TAC, Langley AFB. In charge from 2 July 1962

<u>Report Preparation</u>

Mr. Donald Whittam
Dr. J. W. Brown
Mrs. B. O. McCollough

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* See Appendix C
** Part time on Data Processing

II. MODIFICATION

The spray dispersal equipment installed in C-123B aircraft, number 56-4362, was modified at Olmstead AFB to provide the maximum flow rate possible within the limits of the engine and pump unit used on the MC-1 spray system. This modification included elimination of certain restrictive plumbing between the pump output port and the boom supply hose fittings on the underside of the wing structure within the fuselage. Sharp 90° bends were replaced with smooth gradual bends. A special shop-made "Y" was installed in the 2½" ID line from the pump to divide and carry the flow to the 1-3/4" ID lines leading to the booms. This replaced a "T" fitting originally used.

Both wing booms were reworked. Aluminum blocks approximately 1" square and 3/8" thick were welded along the rear surface of the boom at 8 inch intervals. Holes were drilled and tapped through the blocks and booms to receive a 3/8" pipe nipple. This modification was made to permit the use of Spraying Systems diaphragm check valve nozzle bodies, No. 6140, which has a 3/8" pipe thread. However, since the manufacturer was unable to supply this item before 45 days after receipt of the order it was necessary to modify the No. 6135 check valves on hand. To do this the ¼" pipe thread was drilled out and the hole retapped to 3/8" pipe thread.

Approximately 100 nozzle cap nuts of the type used on the No. 6135 check valve were modified by brazing one half of a 3/8" pipe coupling to it so nozzle tips with a 3/8" pipe thread could be installed on the check valve if desire.

The flow rate of the modified system was tested at Olmstead AFB using water. Herbicide formulations could not be used at Olmstead because of the hazard of these materials to vegetation. The maximum water flow rate obtainable from the system using 100 unmodified S.S. No. 6135 diaphragm check valve bodies from which the cap nut, orifice, whirl plate and strainer had been removed was 230 gallons per minute.

Following this test it was decided to modify the booms, as described above, to permit use of the check valve bodies which were modified for use with a 3/8" pipe nipple.

It was also decided to relocate the flow control gate valve which had been placed in the suction line between the tank and pump. The valve was relocated in the output line. A second gate valve was installed in a line to the tank to return the pump output to the tank when the flow control valve was closed. The shafts of both valves were linked so one closed as the other opened. Both valves were actuated by a single electrically operated actuating unit, which required 5 to 6 seconds to fully open or close the valves.

"Fix Kits" composed of the parts required to accomplish the above modifications can be fabricated at Olmstead AFB and delivered for on site modification of MC-1 equipped aircraft in South Vietnam.

III. CALIBRATION METHODS AND RESULTS

A. Flow rate:

Prior to each spray flight test of the dispersal equipment for evaluating deposit pattern and droplet spectrum produced by the numerous nozzle types and arrangements tested, it was necessary to determine and adjust the flow rate of the system. Because the spray dispersal system is engine driven, all flow rate calibration tests could be conducted as accurately on the ground as in the air.

Permission was obtained to use Field 2 in the Eglin complex for this purpose. Following each early morning spray flight test the aircraft was landed at Field 2 and parked in the same approved location on an unused runway. This spot was selected as one most distant from valued vegetation. Nozzle changes and flow rate adjustments were usually made after the morning's test flight information had been processed and a cursory examination of the results could be made. After completing calibration, the aircraft surfaces contaminated with the herbicide were washed and the airplane flown to the main airfield, if daylight permitted.

It was originally assumed that the herbicide material pumped through the dispersal equipment during each flow rate test would have to be sprayed onto the ground and lost. However, after giving consideration to the amount that would probably be used in calibrating each nozzle configuration to the desired flow rate and the cost of the material, it was decided to try to construct a system to recover as much of the material sprayed from the nozzles as possible.

To accomplish this, four troughs were constructed. Each was made using two boards eight inches wide nailed together to form a 90° vee shaped trough. A light weight wooden frame was added to one side of each trough and covered with "barrier cloth" to deflect the spray emitting from the nozzles downward into the trough. Two troughs were hung under each boom and sloped so the liquid flowed to the outer end of the outboard trough and to the inner end of the inboard trough. Cloth downspouts were made to direct the flow into steel drums from which one end had been removed.

Standard 55 gallon drums were used and measurement of the quanity of solution collected in each drum made by using a calibrated dip-stick. Flow tests were run for 30 seconds and the total gallons collected in the four drums multiplied by 2 to obtain the gallons per minute output of the system. The solution in the drums was then pumped back into the spray tank in the aircraft. Very little, if any, solution was lost during each calibration test.

Although a record was kept of the total time the spray valve was open during each in-flight spray test, no attempt was made to accurately measure the amount of solution released during the flight tests. This would have required removing all remaining solution from the spray tanks, putting it in drums to accurately measure it with a dip-stick and returning it to the spray tanks, before nozzle changes and flow rate adjustments could be made to prepare the dispersal equipment for the next days flight tests. On many days thunderstorms delayed the work leaving little time before darkness to complete the calibration, remove the troughs and wash contaminated surfaces of the aircraft.

One problem encountered while conducting flow rate tests was the rather rapid deterioration of the rubber diaphragms used in the check valves. The Hycar rubber from which the diaphragms are made was apparently attacked by the Purple within a very short time. New diaphragms were swelled, and curled up when removed, after only a few hours exposure to the solution. Although this may not have interferred seriously with their function in the check valve, it was necessary to continually replace diaphragms to reduce nozzle dribble. Frequently it was found that the center of the diaphragm had factured.

It was known that the manufacturer of the check valve made a Teflon diaphragm for use with the Hycar diaphragms in situations where solutions used were deterious to the Hycar rubber. It was not known what effect the Purple might have on the Teflon.

The manufacturer was contacted on this matter but could not promise that the Teflon would withstand the solution we were using but felt quite certain it would not be effected. Therefore, a small supply of the Teflon diaphragms were purchased and installed in the check valves along with new rubber diaphragms.

Up to the writing of this report the Teflon diaphragms appear to be working satisfactorily. 0

On 28 June the following information relative to calibration of the MC-1 dispersal equipment was urgently requested by ARPA for preparing a TWX to "Ranch Hand".

1. Nozzle sizes?

   ¼" Spraying Systems No. 4664 (actually are ¼" 5135) check valve body with cap nut, orifice, whirl plate and strainer removed.

2. Placement?

   On each boom, 1 thru 13 and 27 thru 39.

3. Number of nozzles?

   52 total, 26 on each boom

4. Flow rate?

   ± 135 GPM, suggest timing output in flight and adjust engine throttle setting.

5. Mixture?

   Purple, or 2 parts fuel oil and 1 part Purple

6. Droplet size, MMD?

   ± 250 microns

7. Deposit Rate?

   1 - 1.5 gallons per acre

8. Pump Pressure?

   As required for output

9. Total Swath?

   400 feet inwind to more than 1,000 feet crosswind, 8 mph

10. Effective Swath Width?

    ± 300 feet

11. Meteorological Restrictions?

    Inversion, if possible. Discretion of Capt. Carl Marshall, Ranch Hand Ops.

12. Nozzle Angle?

    Straight to rear

This information was furnished the following day, 29 June, with the limitation that it was the best possible estimate based on the three spray test flights and the data obtained to this date.

The nozzle configuration and flow rate recommended above should be flight tested after completion of the spray test flights necessary for compiling this report.

B. Sampling Grid and Operation.

Sixteen markers 1,000 feet distant from a central point were in place and a circular area cleared on Range 52 South by 18 June*. On 19 June grid stakes and materials arrived and the sample line stations were measured and driven. The grid was completed by 21 June. Training of personnel in servicing the lines was done concurrently.

A grid diagram work sheet (Appendix G) shows the layout of the grid. Each of four 2,000 foot lines contains 100 sampling stations at 20 foot intervals**.

After the first flow rate tests were completed, the first flights were made 24 June. This mission served to point up deficiencies and inadequacies. With greater familiarization and knowledge or requirements, the operational sequence of the grid was firmed up.

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* This work had been accomplished since first notice to Mr. Al Clausen of Eglin AFB on 14 June.

** It is proposed to leave this grid in place upon completion of the mission.

Initial meteorological information, primarily wind direction at spray altitude, was obtained to select a line for inwind flights (the most difficult to obtain). Two jeeps were dispatched with crews and sample cards which had been premarked for stations and clipped to aluminum plates to keep them flat. (Appendix H) Each jeep crew was assigned 50 stations (1-50 and 51-100). During exposure of the cards for a period of 10 minutes after the spray release, information was radioed to the jeep crews as to which line had been selected for the next flight. (In the event of radio failure, a third jeep was used for this communication.) Each crew consisted of three men: (1) a driver, (2) a pick-up and placement man, and (3) a man in the back seat receiving exposed plates and supplying the pick-up man with fresh plates. In addition, the number 3 man kept the plates in sequence, operated the radio equipment, supplied the station number where first drops were visible to the controller, and called in an estimated "ready" time for the next flight. The crews servicing the line remained off the extreme ends of the line during the spray flight and the settling period.

The controller had radio contact with the aircraft via a mobile unit. He indicated to the pilot the heading desired and station to be crossed to compensate for spray drift. The pilot kept stop watch time on the spray release.

The met crew* had instructions to keep the controller supplied with up-to-date information in order for him to select the most appropriate sample line for the next run. Inability to do so, unfailingly, represents in part man's difficulties to predict or control weather.

Another major difficulty encountered was the aircraft pilot's problem of being on course at altitude (150 feet) on a given run over the grid without guide markers a mile or two distant from the grid. This required a familiarization or experience factor which practically dictated the requirement for an experienced spray pilot.**

Several runs were made with constants of 150 foot altitudes and 150 mph until interest was expressed for passes at higher altitudes. Subsequently, passes were made at 200 and 250 foot altitudes, but inwind swath characeteistics appeared relatively stable, perhaps due in the main to large droplet requirements (300 microns, mmd). And again, the higher altitudes of release diminishes the aimability and increases the possibility of drift from attempted inwind flights.

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* At times this crew had difficulties beyond their control which were appreciated by the controller, that is, electronic gear failing the first time out with unfamiliar apparatus, etc. The requirements for this mission were different and unusual to them and really called for gear on a tethered ballon that to the writer's knowledge has yet to be invented. Information concerning wind direction is first and foremost; velocity secondary but important.

** Captains Carlson and Robinson were most cooperative and did an excellent job of handling the aircraft for these missions.

C. Particle Size.

The method utilized for determining mmd is described in Appendix D*. It consists generally of ascertaining and measuring the diameter of the largest qualifying spray droplet collected on special Kromekote cards treated with an oil sensitive dye, applying a spread factor correction and another experience factor to allow for non-homogeniety of the particle size population distribution. It is a relatively rapid method devised, developed and used by USDA personnel for some years in their spray work. Previous methods consisted of microscopically measuring and counting thousands of droplets to determine the mmd, a tedious and time-consuming operation.

Crosswind spray releases are desired for adequate separation of the spray particles in order to collect an array of largest spray drops. On many attempted inwind flights, crosswind effects on the spray were encountered sufficient to provide cards suitable for mmd determinations.

Of the array of nozzle placements, numbers of nozzles and nozzle configurations, and their functioning at different flow rates, most of the mmd determinations were found by the above method to range for the purple coded material between 250 and 350 mmd. (See Appendix E and Summary Data.

D. Swath Widths

Determination of swath widths can be made most accurately by utilizing (and obtaining) truly inwind spray releases under inversion conditions crossing the sample line at right angles. The wind should be unidirectional from the altitude of the spray release to the ground. Usually the deposit pattern under these circumstances will be expressed as a bimodal curve where a split boom system is employed (applicable to the system used in these tests). Variation of deposit can be quite high (see Appendix E) and if applied for biological effect could result in uneven response. Therefore, unless the peaks of the bimodal curve (overdosing) are diminished to approach the desired level and the valley or trough (underdosing) can be sufficiently filled in, the truly inwind flight for effect, although giving the greatest aimability and the least drift, may provide a suboptimal biological effect.

Methods for assaying deposit (or recovery) are described in Appendix D. The method used was the most rapid but perhaps one of the least accurate. In discussions with USDA personnel it appeared to be the most feasible for these tests. Many variables were recognized to be beyond control and it was pointed out that variation encountered between passes only 20 minutes apart could be expected to be quite high compared to data collected from two parallel sampling lines exposed to a single pass. Also variation encountered from day to day could be expected on the average to be high;

* Especial thanks are due to Mr. J. S. Yuill, Mr. D. A. Isler and Mr. Bohdan Makysmiuk for their valuable advice, interest, and assistance in indoctrinating team personnel in the use of this method and the method used for estimating spray deposit and recovery.

therefore, it was decided to tolerate a loss in accuracy of measuring a deposit from a given spray release, diminish the data processing time and obtain information pertinent to a greater array of conditions.

This method consists of estimating the amount of deposit in terms of gallons per acre by comparing test cards with "standards" supplied by USDA personnel. These standards are understood to have been assayed by them and found to be in good agreement with results obtained by other more time-consuming and more accurate methods. Accuracy in "reading" the cards diminishes as the deposit rate increases much above 1½ gallons per acre. In fact, a real problem exists as to how to assay deposits of the order of 3 gallons per acre, a rate expected of the second modification of the C-123/MC-1 spray system currently at Olmstead AFB (Aircraft Number 56-4386). At this time the method has not been used to assay rates of this magnitude which are generally believed to be beyond the useful capability of the method.

Recovery of spray by this method as used by others is believed to average about 80%, ranging from perhaps 60% to somewhat greater than 100%.* Thus, for single swath applications the flow rate may require adjustment upward to allow for a 20% loss of material in achieving a given desired rate of deposition.

(1) Effective Swath Width.

Using data obtained from inwind flights on 2 July 1962, after making comparisons with those obtained on 3, 4 and 5 July (Appendix E) where other modifications of nozzles had been employed, it appeared that the configuration and deposit pattern were the most acceptable obtained, that is, the bimodal curve of deposit was less apparent and approached that of a plateau. This nozzle placement of 2 July was selected for flights after 5 July.

The effective swath width (ESW) for purple (solution 1) on the best inwind flights at 150 foot altitude varied from 200 to 280 feet even though the flow rate ($\pm$ 192 gallons per minute) was sufficient for a 1½ gallon per acre deposit (assuming 100% recovery) for a 400-foot swath.

The ESW for crosswind flights at the above flow rate (including data from runs where inwind flights were attempted but wind shifts occurred) extended from about 300 feet up to about 600 feet (Flight 6, 4 July) for a one gallon per acre deposit.

Although a rule-of-thumb for ESW is that an altitude of release up to four times the total wing span will approach a maximum ESW. This relationship does not appear to hold where the outermost nozzles are considerably inboard of the wing tips and the vortices created by them in flight. This measure, along with increased mmd, has been indicated to re reduce drift of the spray.

* This "impossibility" can in fact occur with turbulent air or wind shifts and is not wholly representative of an inadequacy of the method.

Using purple code material on and data from the best inwind flights which were selected by narrowest total swath:

Date	Flt	Flow Rate (gal/min)	Release Altitude (feet)	Total	Swath Width (feet) 0.5 GPA	1.0 GPA	1.5 GPA	Crosswind MMD
27 Jun	3	206	150	440	280	260	260	300
27 Jun	4	206	150	560	360	340	280	300
1 Jul	1	196	150	540	470	370	270	293
4 Jul	2	194	150	480	260	240	200	333
4 Jul	3	194	150	580	320	240	220	333
6 Jul	1	179	150	760	320	240	240	320
6 Jul	3	179	150	740	320	240	240	353

Using purple code material on attempted inwind flights resulting in wider total swaths:

24 Jun	1	180	150	940	800	400	300	250
27 Jun	1	206	150	1040	600	300	260	300
27 Jun	2	206	150	1500	400	300	300	293
27 Jun	5	206	150	1520	500	320	280	300

(2) Total Swath Widths.

The array of total swath widths is presented in Appendix E, Consolidated Summary.

Total swath widths for purple sprays have essentially covered the entire length of the sample line (2,000 feet) when released on crosswind flights.

IV. DISCUSSION

There are numerous variables involved in any attempt to control spray deposit and swath width.

a. Pump capacity - gpm.

b. Pressure drop from pump to nozzles.

c. Number of nozzles.

d. Placement of nozzles.

e. Nozzle characteristics.

f. Solution being sprayed.

g. Altitude of spray release.

h. Airspeed of spray aircraft

i. Prevailing meteorological conditions including:

(1) Wind directions from spray altitude to ground.

(2) Wind velocities from spray altitude to ground.

(3) Temperatures encountered through spray fall.

(4) Humidity.

It should be recognized that where parameters of flow rate, particle size and swath width or deposit characteristics are requested with a view to increasing aimability and preventing drift, the adjustments necessary to obtain the first two determine to a great degree the limits of the third parameter. Further, the number of nozzles, and their placement, have a bearing on flow rate as does pump pressure adjustment. The latter also has a bearing on nozzle performance, a certain minimum pressure being required to activiate the check valve assemblies of the nozzles and if the pressure is marginal an on-off pulsing of nozzles was experienced.

Because of the above interrelationships, considerable time was required to examine several adjustment conditions and to obtain a feed-back of information on performance.

It may well be that conditions obtaining for certain of the flights were so unsuitable that the data may be of questionalbe valve. Nevertheless, they are presented for appraisal by others schooled in the necessary arts.

In 18 days, from 24 June to 11 July, 11 missions were flown each consisting of 4 to 8 spray flights per mission. Weather aborted 1 day and 6 days were missed for aircraft maintenance, spray equipment repair, and spray pilot evaluation. Data for 59 spray flights are presented in Appendix E

and in the Supplement to this report. Conditions for two spray flights were so obviously poor the data was discarded.

The data obtained on 10 and 11 July were from sprays of the mix and of fuel oil, respectively. The results gave an indication that perhaps the system should ordinarily be functioned at relatively high pressures to insure individual nozzle performance. Further, the system itself, being modified for the most output, may become inefficient for spraying at lower rates. Approaches to increased efficiency at lower outputs may include using smaller aperture nozzles already mounted on separate interchangeable booms, or working out and testing a reduction in numbers of nozzles in conjunction with reduced pump pressures.

Because an extended period may be required to determine optimal settings for deposition rates of 0.5, 1.0, 1.5 and maximum for each of three solutions, and because of the prevailing urgency, it is proposed that various swath widths for rates of deposition shown in the basic data (Appendix E - Consolidated Summary) be used.

More and better data are needed to appraise the mix and fuel oil sprays by this system. It is proposed to obtain two more missions for each solution with the current modification.

A total of 45 separate flow rate and nozzle configuration tests were run on the ground at Field 2. One with water, 27 with Purple, 16 with a mixture of 2 parts fuel oil and 1 part Purple and one with fuel oil only.

The maximum output of the dispersal system when Purple is pumped appears to be about 206 GPM, through 74 to 78 nozzles depending on their position along the booms.

Maximum output obtained with the fuel oil and Purple mixture was 227 GPM through 74 nozzles.

During some of the tests conducted to obtain maximum flow it was observed that the diaphragm check valves chattered where an attempt was made to use too many nozzles. It was then discovered that where the number of nozzles was reduced to the point where no chatter was present the output increased. This is indicated in the data on calibration tests nos. 3 thru 8.

When the output was lowered to 150 GPM, 52 3/8" G135 nozzles were used and the engine operated at approximately 1/2 throttle. This calibration produced the same output with Purple, with 2 parts fuel oil and 1 part Purple or with pure fuel oil.

It should be mentioned here that the viscosity of the Purple used at Eglin appeared to be somewhat lower than that of Purple used in other areas. This was the opinion of several individuals who had seen or worked with both materials.

Essentially all of the data collected are presented in Appendix E, however, time to apply valid, necessary corrections to allow for the angle of deviation of an attempted inwind flight ($\pm$ 15° requires no correction) and to evaluate the data has been insufficient, nor has the meteorological information been available in many instances to obtain the needed corrections.

It is recognized that a truly inwind flight will provide the narrowest swath and as the flight pass deviates from exactly inwind, droplet sizing (separation, "shake-out") will occur and be progressivley greater with the flight deviation. Under truly crosswind conditions this separation is most pronounced.

If one considers a release where the wind direction and velocity at spray altitude differs 90 degrees and perhaps 5 mph from ground conditions, the spray is exposed to a spiraling or "corkscrew" effect while settling. These conditions have been encountered and may not be too unusual.

In operating the sampling grid there is an unavoidable lag of 10 to 20 minutes between receiving meteorological information, selecting and preparing the sampling line, and getting the spray delivered. As soon as the spray was released the "met" information was immediately taken at altitude and at 50 foot intervals down to the ground. A 10 minute wait is required for the spray to settle before picking up the sampling cards. At the time the "pick-up" starts the "met" information is available for selecting the sampling line for the next run. If the same line is selected the collection and replacement of cards requires about 5 minutes, otherwise about 10 minutes is needed. Thus, the intended inwind or crosswind condition on which the line selection was based may shift considerably with or without the knowledge of the controller. The results frequently can be found to be labelled "inwind" or "crosswind" reflecting an attempt to obtain the appropriate information but the data plots are indicative of what was actually obtained.

The "Purple Catchers", troughs fabricated for placement on the spray booms to recover the solution sprayed from the nozzles during ground calibration of the dispersal equipment were of tremendous value in conducting this phase of the program. Not only did they result in considerable economy by permitting re-use of the costly spray solution but they afforded a relatively simple and accurate method of measuring the flow rate of the dispersal system.

Although some solution was spilled during the many calibration tests conducted due to minor accidents and leaks which developed in the troughs through handling and deterioration of the cloth used to cover them, the work area was kept reasonably dry and contamination to a low level.

However, considerable improvement could be made in the "Purple Catchers" if they were constructed of more durable material and design improvements were incorporated. The troughs should be fabricated of aluminum to be imperious to solutions used and for lightness to make handling easier. Two troughs should be provided for each wing boom and one for the center boom if a center boom is used. Each trough should be sloped from its center toward each end so the solution can be collected in two open top drums placed under each trough. Easily attachable aluminum downspouts should be provided of sufficient length to reach from the trough ends to the drums.

Each trough should have a circular cross section to provide a surface which would extend from just forward and below the boom up around and behind the boom to a point directly above the boom. The upper portion of the trough should be slotted where boom braces are encountered. Suitable attaching fittings should be built into the trough assembly so it can be easily but securely hung on the boom.

It is anticipated that the suggested troughs and downspouts would not be too large to be transported aboard the C-123 aircraft and thus be available for ground calibration of the dispersal equipment at anytime. Further, it is expected that their use would permit calibration without serious contamination of the ground or nearby areas.

V. CONCLUSIONS.

Although most of the data collected have been used primarily to provide information for modification and adjustment of the spray system, tentative parameters of system performance up to but not including biological effectiveness are reflected in the following conclusions. Tests with this modified system offer no basis for relating biological effects achieved elsewhere which ranged from 60 to 90 percent or higher (reference 3) with a previous C-123 system (original Ranch Hand equipment) related to this modification.

1. The inclusion of a suitable flow rate meter in this system is desirable for both testing and operational use (references 1 and 2).

2. The nozzle configuration and flow rate tested 1 and 2 July (Appendix E) appeared to be the most desirable of those flight tested using Purple code material. This configuration produced an effective swath of approximately 300 feet at a deposit of 1.5 gallons per acre. The mass median diameter of the spray was approximately 293 microns.

3. From the flow rate data obtained to date on the modified MC-1 dispersal equipment in C-123, 56-4362, it appears that the maximum output with Purple is approximately 206 GPM. This using 70 3/8" G135 check valves only without any restricting nozzle orifice. Maximum flow pumping the fuel oil and Purple mixture would be approximately 225 GPM. Maximum flow rate with pure fuel oil was not determined.

4. These maximum flow rates are apparently limited by the pump capacity and engine power as the maximum output obtained with water at Olmstead AFB was about 240 GPM without the booms attached to the flow lines.

5. Flow rates within the maximum limit of a dispersal system can normally be adjusted by changing the pressure in the system, although this does vary the droplet size produced by the nozzle orifice somewhat. However, in this dispersal system where a maximum number of nozzle outlets are operated at relatively low pressure to produce a maximum coarseness of spray and check valves are used to prevent dribble, it becomes inpractical to lower the output to half or one third by merely reducing pump speed which will result in a pressure drop at the nozzles, as this results in poor operating of the check valves and intermittent output.

6. It is therefore necessary to reduce the output by removing or shutting off a suitable number of nozzles so that each remaining nozzle continues to operate at approximately the same pressure and produce the same individual flow.

7. In reducing the total number of nozzles in the boom span it should be possible to close nozzles between others so the calibrated flow continues to originate generally from the same areas on the boom.

VI. RECOMMENDATIONS

1. It is recommended that the basic data of this report be evaluated by an organization of an operational research type having the necessary appropriate talent and facilities. Such an evaluation could provide guidance for a second modification and its testing.

2. Based on spray performance characteristics presently available for the first modification (C-123 aircraft number 56-4362) it is recommended:

a. That the MC-1 dispersal equipment in Ranch Hand C-123 aircraft be modified with "Fix Kit" parts and modified booms and nozzles to permit them to operate with the nozzle configuration and flow rate tested 2 July.

Specification of nozzle arrangement are: 72- 3/8" G135 Spraying System diaphragm check valves only and directed to the rear, located on each boom at stations 1 through 7, 13 through 21 and 29 through 40.

16-¼" G135 Spraying Systems diaphragm check valves, only, directed to the rear, located on each boom at stations 1 through 4 and 37 through 40. Pump pressure - approximately 32 psi. Flow rate - approximately 196 gpm.

b. That Teflon diaphragms be installed in all "Ranch Hand" aircraft handling purple or similar solution which are found to deteriorate the Hycar rubber diaphragms. When the Teflon diaphragms are installed in the check valves new rubber diaphragms should be installed behind them in accordance with Spraying Systems instructions.

c. That Olmstead AFB be requested to fabricate suitable "Purple Catchers" for use with the second Mod C-123 aircraft.

d. That where maximum droplet size and aimability is a parameter that reduced flow rates be accomplished by reduction in nozzle guanity and spacing be such that the calibrated flow originate from basically the same boom areas as those found suitable for higher outputs.

e. That a large strainer having a flow rate at least 3 times the maximum capability of the dispersal equipment be installed between the tanks and the pump. The screen should be 50 mesh and easily removed for cleaning without spilling solution when the tank is empty.

3. Each C-123 aircraft modified should have performance data test flights before release from MAAMA. Recommend that, due to the type of flying, periodic inspections be scheduled at 150 or 200 hours instead of 300 hours.

VII. REFERENCES

1. Preliminary Report of Vegetational Spray Tests.
2. Vegetational Spray tests in South Vietnam (and classified Supplement).
3. Review and Evaluation of ARPA/OSD "Defoliation" Program.

APPENDIX A

ASSIGNMENT AND IMPLEMENTATIONS

ADVANCED RESEARCH PROJECTS AGENCY
WASHINGTON 25, D.C.

1 June 1962

MEMORANDUM FOR THE COMMANDING GENERAL
US ARMY CHEMICAL CORPS
RESEARCH & DEVELOPMENT COMMAND

SUBJECT: Modification and Calibration of Defoliation Equipment

It is requested that representatives of the Research and Development Command, U.S. Army Chemical Corps participate as a team member with the Air Force and the Department of Agriculture in the necessary modifications to and calibration of the high volume herbicide spray dispersal unit (Modified MC-1, "Hour Glass") presently utilized aboard C-123 aircraft for defoliation operations. This modification is to achieve controlled deposition of up to three gallons per acre of herbicide material in droplet size 200 to 400 microns diameter (300 microns considered optimum). The desired spray path to be approximately 500 feet in width with maximum homogeneity of deposition per application. Controlled and instrumented operational tests are to be conducted in the CONUS for physical calibration of the equipment and verification of deposition rates, droplet size, and deposition homogeneity.

The CmlC Research and Development Command is requested to act as executive agent and coordinator for the accomplishment of this program, insuring that the program is satisfactorily completed at the earliest practical time, and issuing the final report which will outline in detail those modifications made to the equipment and the results of the physical measurements made.

Primary contact within the Air Force and the Department of Agriculture are.

Air Force: AFOOP, Deputy Chief of Staff Operations
(Lt Colonel W. F. Middledorf)
Dept of Agriculture: Plant Pest Control Division
ATTN: Dr. Emory D. Burgess, Director
(Mr. Donald Whittam)

An amended ARPA Order, 256 Amendment No. 4, copy attached, provides funds in the total amount of $75,000.00 for the conduct of this program.

Attach
a/s

J. P. Ruina
Director

cc: Secretary of the Army

Backup: APC #525

ARPA Order No. 256-62
Amendment No. 4
Project Code No. 8600
Industrial Priority Rating: DO

1 June 1962

TO: Chief Chemical Officer
Department of the Army
Washington 25, D. C.

1. It is requested that a modification and test program be initiated for the MC-1 herbicide dispersal equipment. The objectives of this program are to alter the present equipment to produce herbicide droplet size of approximately 300 microns diameter, homogeneity of deposition in a spray swath of 500 feet, and a deposition rate up to three gallons per acre. It is ARPA's intent that this program will be participated in jointly by the U. S. Department of Agriculture, U. S. Air Force, and the Army Chemical Corps, with the latter as Executive Agent. Estimated cost is $75,000 for a required effort of approximately two months.

2. The fund availability for work under this Order is hereby increased by $75,000, from a previous total of $68,200 to a new total of $143,200 under appropriation and account symbol "97X0113.001 Salaries and Expenses, Advanced Research Projects Agency, Department of Defense."

J. P. Ruina
Director

Copy to: Secretary of the Army
Chief, R&D/Army

Prepared by: DHelm/jfu/5/31/62
OSD/ARPA(OM) 3E183, x57071

HEADQUARTERS
U. S. ARMY CHEMICAL CORPS RESEARCH AND DEVELOPMENT COMMAND
WASHINGTON 25, D.C.

CMLRD-BR 6 June 1962

SUBJECT: Modification and Calibration of Defoliation Equipment

TO: Commanding Officer
U. S. Army Chemical Corps Biological Laboratories
Fort Detrick
Frederick, Maryland

1. Reference telecon between Dr. Sporn, this Headquarters, and Mr. Hayward, your Command, on 29 May 1962.

2. The attached memorandum, with Funding Order No. 256-62, from the Advanced Research Projects Agency, is forwarded for necessary action. Particular attention is invited to the 2nd paragraph of the memorandum.

3. The funding allocation will be broken down in the following amounts:

a. $30,000 to U. S. Army Chemical Corps Material Command for the purchase of necessary herbicides (2,4-D and 2,4,5-T). Please note that procurement has already been initiated.

b. $20,000 to U. S. Air Force for modification of equipment, travel, etc.

c. $23,000 to U. S. Army Chemical Corps for personnel and equipment.

d. $2,000 to Department of Agriculture for necessary travel.

4. It is requested that the modification and necessary testing, including the final test report, be performed as soon as possible, with a target date of completion 6 July 1962. This final report is expected to be a coordinated effort of the Chemical Corps, U. S. Air Force, and the Department of Agriculture.

5. Confirming paragraph 1 above, it is understood that Dr. C. E. Minarik, your Command, will act as the Operations Coordinating Officer.

CMLRD-BR
SUBJECT: Modification and Calibration of Defoliation Equipment

The contact officers at Headquarters, Research and Development Command will be Major William S. Vargovick or Dr. Eugene M. Sporn.

FOR THE COMMANDER:

/s/ Kenneth I. Bechtold
KENNETH I. BECHTOLD
Lt Col, CmlC
Executive Officer

1 Incl
ARPA Memo
dtd 1 Jun
1962.

CMLRD-BL-13-C

ARPA Calibration Tests

Dir/Biological Research

Chief, Crops Division

31 May 1962
cmw/2202

1. ****************

5. Dr. James W. Brown will be the CmlC project officer for this test***
************.

C. E. MINARIK
Chief, Crops Division

Copy furnished:
Scientific Director

NNNNCZCKPB955ZCJJ0843
RR RJEZKP
DE RJEZHC 1242 5 JUN 62 05 47
R 04220962Z
FM HQ USAF WASH D C
TO RJEZDX/TAC LANGLEY AFB VA
RJEZFF/AFSC ANDREWS AFB MD
INFO RJEDSO/AFLC WRIGHT PATTERSON AFB OHIO
RJEZKP/MOOMA OLMSTEAD AFB PA
RJESSB/APGC EGLIN AFB FLA
RJESGB/SPECIAL AIR WARFARE CENTER EGLIN AFB FLA
RUEPAM/USAF ARMY CHEMICAL CORPS R AND O COMMAND WASH D C
AF GRNC

UNCLAS FROM AFOOP-00 94626
SUBJECT ARPA SPRAY TEST WITH C-123 AIRCRAFT. REFERENCE TELECON BETWEEN L/C MIDDLEDORF THIS HEADQUARTERS AND MAJOR COATES HQ. TAC.

PART I FOR TAC. REQUEST YOU MAKE TWO REPEAT TWO C-123 SPRAY EQUIPPED AIRCRAFT AND CREW AVAILABLE FOR ARPA SPONSORED AND FUNDED DEFOLIANT SPRAY TESTING. CHEMICALS TO BE EMPLOYED WILL BE BUTYL 2,4 D AND 2,4, 5-T (COMMON WEED KILLER). TEST SPRAY OPERATIONS WILL BE CONDUCTED AT EGLIN AFB AND WILL LAST FOR APPROXIMATELY 4 WEEKS.

PART II. FOR ALL. BEFORE TESTING CAN BEGIN MINOR MODIFICATION WILL HAVE TO BE MADE ON ONE AIRCRAFT AND RATHER EXTENSIVE MODIFICATION WILL HAVE TO BE ACCOMPLISHED ON THE SECOND. MOOMA CONTACT FOR THIS WORK WILL BE MR. SELLERS, PHONE 73128, 71103 OR 73110. YOU WILL BE NOTIFIED WHEN AIRCRAFT ARE TO BE DELIVERED TO MOOMA. BECAUSE OF URGENCY OF THIS PROJECT, REQUEST FULLEST COOPERATION AND ASSISTANCE BE PROVIDED BY ALL AGENCIES. PART III. MISTER DONALD WHITTMAN OF DEPARTMENT OF AGRICULTURE AND DOCTOR CHARLES E. MINARIK OF ARMY CHEMICAL CORPS WILL BE AT MOOMA TO OUTLINE SPRAY MODIFICATION REQUIRED ON EACH AIRCRAFT AND, WILL DIRECT THE SPRAY TESTING. PART IV FOR AFSC. REQUEST YOU APPOINT A PROJECT OFFICER FROM APGC WHO WILL MAKE LOCAL SUPPORT AND TEST ARRANGEMENTS AND COORDINATE WITH PARTICIPATING AGENCIES. LABORATORY SPACE OF APPROXIMATELY 25 X 25 FEET, INFILTERED FUME HOODS, BENCH SPACE AND WATER WILL BE REQUIRED. GROUND TRANSPORTATION FROM THE LABORATORY TO TEST SITE AS WELL AS OTHER SUPPORT WILL BE REQUIRED. REQUEST NAME OF PROJECT OFFICER BE FORWARDED TO HQ USAF ATTENTION AFOOP-00 WITH INFO COPY TO ARPA. PART V FOR TAC. SUGGEST MAXIMUM PRACTICAL PARTICIPATION OF ACTUAL TEST AND ANALYSIS COMBAT APPLICATION WING, SAWC. DETAILS TO BE COORDINATED LOCALLY WITH APGC.

BT
05/0154Z JUN RJEZHQ

HEADQUARTERS
U. S. ARMY CHEMICAL CORPS RESEARCH AND DEVELOPMENT COMMAND
WASHINGTON 25, D. C.

CMLLD-P.3 11 June 1962

SUBJECT: Modification and Calibration of Defoliant Equipment

TO: Commanding General, U. S. Army Chemical Center and CmlC Material Command
Commanding Officer, U. S. Army CmlC Biological Laboratories

1. Reference is made to ARPA Order No. 256-62, Amendment No. 4. The required date for the item at Eglin Air Force Base and Olmstead Air Force Base is 20 June 1962.

2. Pursuant to the designation of the Chemical Corps RDCOM as the executive agent and coordinator for the accomplishment of the program by Memorandum for the Commanding General, RDCOM, a priority designation of IV A is assigned to the requisition.

3. Attention is invited to ASPR 3-202.2(VI).

FOR THE COMMANDER:

/s/ Lowell E. Thompson
LOWELL E. THOMPSON
Lt. Colonel, CmlC
Project Manager

cc: USACPD, NY

MEMORANDUM FOR RECORD

CMLRD-BL-13-C   18 June 1962

SUBJECT: Modification and Calibration of Defoliation Equipment

1. The final report for subject task has a target date of 6 July 1962 by CmlC R&D Command (reference letter of 6 June 1962, para. 4).

2. Guidance is requested as to manner, place of reproduction, number of copies required, and who should receive the material, as it is generated for processing.

3. The report is expected to contain material prepared by elements of Olmstead Air Force Base, Eglin Air Force Base, Tactical Air Command, the U. S. Department of Agriculture and the Chemical Corps.

4. Information desired in the report includes "in detail those modifications made to the equipment and the results of the physical measurements made," (reference: ARPA Memorandum of 1 June 1962, above subject).

5. Although not specifically mentioned in the reference cited in paragraph 4 above, two separate modifications are involved, the second of which may require information obtained from the performance of the first.

6. Mr. Don Whittam, USDA, the undersigned, and a crew of five from Crops Division, Fort Detrick, are scheduled to arrive at Eglin AFB 18 June 1962. It is expected that the first C-123 modification will arrive 19 June and ten drums of the chemical on 20 June. The remainder of the chemical is expected by 22 June.

7. For each system modification the work sequence planned includes:

a. Flow rate adequacy and settings required for solutions of:

(1) Purple

(2) 2 parts fuel oil, 1 part purple

(It has been discussed with USDA personnel in the interests of saving time that a third solution (1 part fuel oil, 2 parts purple) may be estimated reasonably as midway of solutions 1 and 2. If time allows or if necessary solution 3 will be tested. Each flow rate determination can be tested without flight, however, a flight release will be made for check-out of flow rate performance.

If duplicate readings for each solution vary more than $\pm$ 5%, additional trials are planned to diminish the error to about this level. Mr. Whittam will supervise the work.

b. For each solution, particle size determinations will be checked using the "D-max" method devised by USDA personnel. This involves cross-wind flight releases over a sample line along which oil sensitive dyed cards will be exposed. Measurement of the largest drops collected can be used to estimate the mmd of the spray particles. Three good, separate passes by the aircraft per solution are deemed sufficient. Eight passes may have to be made to obtain 3 "good" collections.

c. For each solution, swath width and deposit patterns will be determined. Inwind flight releases perpendicular to a 2,000-foot sample line with card collection stations at 20-foot intervals will be required under early morning inversion conditions. It is anticipated that these determinations will be the most difficult, having been advised that far greater variation occurs between passes as opposed to variation encountered where two parallel sample lines were exposed to the same pass. The inversion conditions are a discrete requirement and may be acceptable from sunrise to perhaps 0800 if weather otherwise is not limiting. Winds greater than 8 mph have been suggested as unsuitable. Data collection and processing will lead to graphs of swath widths and deposit levels achieved.

8. The above tentative plans have been developed from information obtained by joint meetings at Olmstead AFB, Eglin AFB, and at USDA, Beltsville, Maryland, and numerous phone calls since 31 May 1962. Revision of plans may have to occur as the work progresses.

J. W. BROWN
Deputy Chief, Crops Division

APPENDIX B

RECOMMENDED APPROACH

6 July 1962

MEMO FOR RECORD

1. The attached joint recommendations were presented to OSD/ARPA on or about 26 June 1962 by Lt. Colonel Thompson, CmlC. Verbal action indicated by OSD/ARPA was communicated to Dr. Brown by Lt. Colonel Thompson via telecon the same day.

OSD/ARPA's instructions follow:

Steps 1 thru 5: Do

Step 6: To be done jointly by USDA & Fort Detrick.

Step 7: Not now - will consider later.

Step 8; Do.

In regard to the data chart:

Do line B first, then proceed to fill out data chart.

2. A call to the undersigned by Capt. Savadkin, USN, OSD/ARPA this date indicated that Navy preparations were current to bring in a helicopter to Eglin AFB during the week of 16 July 1962 for a period of 7 to 10 days for execution of Step 8. Captain George S. Stains, USN, two technicians and a helicopter crew are expected to be present for the conduct of these tests. APGC Major Leland Tucker, and/or Capt. Ralph W. Weaver have been indicated as contacts for receiving the Navy team and equipment.

3. Additional funding is anticipated by OSD/ARPA for the work to be performed as cost estimates become available.

/s/ J. W. Brown
J. W. BROWN

Atch
a/s

25 June 1962

C-123 ARPA SPRAY TEST PROJECT

JOINT RECOMMENDATIONS
of Project Team at Eglin AFB

Dr. James W. Brown, Biological Lab., Fort Detrick, Maryland
Mr. Don Whittam, USDA, Beltsville, Maryland
Lt. Colonel Lowell Thompson, R&D Command, Washington, D. C.
Capt. Edgar H. Carlson, USAF TAC Project, Langley AFB, Va.

Recommended solutions for first modified aircraft C-123B 56-4362 so that statistical correlations can be made of other than a single pre-set configuration using only one chemical concentration. This information will be essential if comparative technical evaluations are to be made, if changes in employment principals and/or deposition rates are to be made.

Steps for proper conduct of tests. Not necessarily done in sequence, may be done concurrently.

1st Step: Obtain calibration data on nozzle settings for flow rate. (Ground).

2nd Step: Runs to get nozzle settings standarized to give best possible patterns (aimability) Particle size of ESW.

3rd Step: Statistical data for data chart.

4th Step: Data fed back for MOD 2 equipment design and test plan.

5th Step: Repeat 1, 2, and 3 above for MOD 2.

6th Step: Scientific Evaluation of data for MODS 1 & 2 to determine useful applications thereof.

7th Step: Restore one Ranch Hand aircraft to original configuration and run calibration with purple band concentrate to solve for ESW and MOD. Failure to run this calibration will eliminate the possibility of correlating technical evaluation of original modification and there by render impossible evaluation of original work to MODS 1 & 2.

Alternate suggestion. If it is impossible to use purple band for calibration, utilize #2 fuel oil which will at least provide information from which an interpolation can be made to salvage the previous test efforts.

8th Step: Suggest that HIDAL be flown over grid at 25, 50, 75 foot altitudes with purple, mixes and #2 fuel oil for estimates of system performance.

Captain George Stains, Naval Air Station, Jacksonville, Florida, is suggested contact.

DATA CHART FOR FIRST MODIFICATION ONLY

	I FLOW RATE O/ACRE	II ESW	III AIMABILITY	IV PARTICLE SITE	V % RECOVERY
A.	Max	1,2,3*	1,2,3	1,2,3	1,2,3
B.	1.5	1,2,3	1,2,3	1,2,3	1,2,3
C.	1.0	1,2,3	1,2,3	1,2,3	1,2,3
D.	0.5	1,2,3	1,2,3	1,2,3	1,2,3

Min: 2 Good Flights inwind. 1 Good Cross-Wind.

*1. Purple
2. 2 Fuel Oil - 1 Purple
3. Fuel oil

Guide Lines Present: 1.5 gallon/acre, ± 300 mmd ± ESW - 500'.

Need Guidance: % Recovery acceptable, aimability limits acceptable for friendly and for enemy area targets.

This will give an engineering evaluation of this weapon system, and provide guidance for technical changes in the field.

APPENDIX C

PERSONNEL

PERSONNEL

U. S. Army CmlC R&D Command, Washington, D. C.

Lt. Colonel Lowell Thompson	Project Manager

USDA, Beltsville, Maryland

Mr. Donald Whittam

U. S. Army CmlC, Ft. Detrick, Maryland

Dr. James W. Brown	Crops Div., Project Officer
Mr. Lester W. Boyer	Crops Div.
Mr. William B. Johnson	"
Mr. Raymond Anders	"
Mr. Charles Boyles	"
Lt. Charles Quibell	"
Lt. Charles A. Francis	"
Lt. Charles W. Fuller	"
Lt. Paul E. Wampner	M. D. Div.
Mr. Paul Riley	Tech. Info. Div.

U. S. Army Chemical Corps, Ft. McClellan, Ala.

Sgt. William Hale
Cpl. Howard Hemmingway
Cpl. Ralph C. Newson
Pfc. Laurin L. Gould
Pfc. Max Hopkins
Pfc. George R. Sharp
Pvt. Donald H. Lyons

4500th Ops Sq., Langley AFB, Va.

Capt. Edgar H. Carlson	Mission Pilot
Capt. Claude T. Adams	
Capt. William F. Robinson, Jr.	Mission Pilot
SSgt. Hughie R. Blankenship	
SSgt. James L. Camden	
SSgt. Roy N. Coats	
SSgt. John A. Mesic	
SSgt. William A. Mullen	
SSgt. Keith D. Yale	
A1C James H. Reed	
A3C Robert E. Offerman	

Eglin AFB, Fla.

Maj. Leland Tucker	Project Officer
Capt. Ralph W. Weaver	
2d Lt. Vernon L. Hazen	

MAAMA, Olmstead AFB, Pa.

Mr. Glenn Hipple
Mr. Ken Baird

Dugway Proving Ground, Utah

Mr. William Hazlem

Troop Carrier Sq., Pope AFB, N. C.

Capt. Paul A. Dehmer, Jr.
Capt. Vencel Makva
Capt. John J. Pietenpal
Capt. Larry R. Youngren
1st Lt. George T. Adams
1st Lt. Richard G. Haupt
1st Lt. Deane E. Smith
TSgt. Oscar G. Garringer
SSgt. Earle H. Briggs
SSgt. Fiedl R. Mesic
SSgt. Reginald I. Nelson
SSgt. Otis Thompson
A1C Denver L. Gleason
A1C John T. Lucas
A2C Bobby G. Duncan
A2C Kenneth G. Gardiper
A2C William T. Hartford
A2C Vernon L. Jacobs
A2C Ronald L. Tincher
A3C James D. Schroeder

APPENDIX D

U. S. DEPARTMENT OF AGRICULTURE

Methods

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Forest Insect Laboratory
Agricultural Research Center
Beltsville, Maryland

5240
Ref: CMLRD-BL-13-C 6/18/62

June 22, 1962

Dr. J. W. Brown, Deputy Chief Crops Division
Chemical Corps Biological Laboratories
Fort Detrick
Frederick, Maryland

Dear Jim:

In response to your request the following is an outline of various procedures for evaluating the distribution characteristics of aerial spray equipment as discussed in our recent conferences.

A. Flow rate calibration.
   1. Time to discharge a known volume -- See enclosed "Notes on some items involved in checking contract spray planes" by D. A. Isler, April 1958, pages 3 & 5.
   2. Volume discharged in a given time.
      a. Fill tank to a predetermined specific level or mark.
      b. Discharge for a timed period -- about one minute.
      c. Measure volume required to refill to original level.
      d. Calculate the discharge rate in gpm.

With either method, duplicate runs should be made. If there is over 5% difference, further replication would be desirable.

The two methods are equally accurate. Choice depends on the particular spray equipment and the testing facilities at hand.

B. Swath width
   1. Dyed cards.
      a. Sample line. Lay out one or more lines at right angles to prevailing wind, length sufficient for a transect of full swath. In your case we estimated 2,000 feet. Interval -- 5 to 20 feet depending on precision desired; we suggest 20 feet.
      b. Sampling surface -- red-dyed cards. Set out one at each sampling point.
      c. Fly plane upwind and over center of sample line, altitude not less than equivalent of one wing-span, for C-123 not less than 120 feet. Flight straight and level, constant air-speed. Full flow of spray 1,000 feet before crossing sample line; continue for not less than 2,000 feet after crossing line.
      d. Collect cards 10 minutes after flight. Hold separated until drops have spread fully (possibly 12 hours for your spray agent).

e. Estimate deposit by matching with "standards" (Sets of standards and instructions have been furnished from this laboratory). You will have to determine the spread factor for your spray agent; details of this procedure previously furnished.
f. Make a minimum of three replicate flights. You will have to determine how much cross drift effect and other variation is tolerable.
g. Plot deposit swath on coordinate paper. For averaging replicate flights match at the low point in the trough of the bimodal curve.

The dyed card method is the simplest, most rapid but least accurate of the procedures listed herein. With a few hours training inexperienced personnel should be able to estimate deposits at the rate of 100 to 200 cards per hour. From our experience, the accuracy probably will range from ± 0.25 to 0.5 gpa at the peaks.

2. Black dyed spray on white cards.
   a. Dissolve Sudan Black dye in the spray, about 4 lbs/100 gals.
   b. Set up and fly test same as in 1 above <u>except</u> use undyed (white) cards of the same paper stock.
   c. With this method you will have to develop standards for visual estimate. This will require a series of flights in which deposits are also measured by the dye tracer method. See item 3 below.

The disadvantages of this method are (1) dye must be added to the spray (we do not know the solubility in your agent); (2) the preparation of standards requires considerable time for the flights and the additional laboratory work. The accuracy is appreciably greater than for the dyed card method; in our work the accuracy is from about ± .05 gpa in the tails of the swath to ±0.25 gpa at the peaks.

3. Dye tracer
   a. Dissolve a dye (Sudan Black, Oil Red, etc.) in the spray as in 2a above.
   b. Set up and fly test as in 1 above except use two 6x6 inch metal plates at each sampling point.
   c. After flight, collect plates; turn sprayed surface of a pair facing each other.
   d. In the laboratory, wash deposit from each pair of plates with acetone spray. Measure the amount of dye in the washing by means of a colorimeter or a spectrophotometer. With either instrument it is necessary to prepare a calibration curve for each batch of spray.

This is the most accurate but slowest of the three methods. The sensitivity is in the order of ±0.05 to 0.1 gpa when the colorimeter is used and about ±0.02 gpa with the spectriphotometer. The disadvantages are (1) Dye must be added to spray; (2) The dye will fade in sunlight so

tests must be run before sunrise or after sunset; (3) The entire procedure of handling plates and measuring the deposit (quantity of dye) is very tedious and time consuming (in our work 15 to 20 man hours per flight for this phase alone).

Considering the requirements of your project, the urgency for early completion of the work, and the wide variation inherent in aerial application, you may find it most practical to select a simple, rapid, less precise method and put more emphasis on making a greater number of replicate flights.

C. Atomization.
   1. The D-max method is probably the most practical procedure for your tests. It is described in the enclosed article, "A rapid method for estimating the atomization of aerial sprays" by Bohdan Maksymiuk.
   2. Separating the largest drops is much easier if the flight is made in a light cross wind, up to about 6 mph.

We hope the above gives the information you need. If you wish additional details please let us know.

Sincerely yours,

/s/ Stu
J. S. Yuill

Paper No. 62-119

METHODS USED IN FOREST SPRAYING FOR EVALUATION OF COVERAGE AND DROP SIZE 1/

by

D. A. Isler
Agricultural Engineer
Agricultural Engineering Research Division
Agricultural Research Service
U. S. Department of Agriculture

For Presentation at the 1962 Annual Meeting
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Mayflower Hotel
Washington, D. C.
June 17-20

1/ Based on work carried out jointly by Beltsville Forest Insect Laboratory, Division of Forest Insect Research, Forest Service, and Agricultural Engineering Research Division, Agricultural Research Service, U.S.D.A.

METHODS USED IN FOREST SPRAYING FOR EVALUATION OF COVERAGE AND DROP SIZE

by
D. A. Isler, Agricultural Engineer

The airplane is the only practical tool for application of insecticides to large forest areas. At the present time these materials are applied as sprays -- principally oil solutions. Since DDT became available more than 20 million acres have been sprayed by aircraft in the United States for control of forest insects.

The ability to evaluate spray coverage and drop size is important to research workers. It is required in the development of equipment and operating procedures to improve the uniformity of distribution of material and to produce sprays having the most effective degree of atomization.

Personnel responsible for control programs also need methods for measuring the performance of contractors' application equipment in order to determine whether or not contract specifications are being fulfilled. Even more important is the determination of the effectiveness of the distribution of the material by the aircraft.

EARLY METHODS

When DDT sprays were first applied for forest insect control, glass plates were laid out in a line or lines through the forest at right angles to the proposed lines of airplane flight. After the area was sprayed the plates were collected and visually examined to determine whether or not adequate coverage had been obtained. The examination was entirely subjective - no quantitative measurements were made from these plates. Except for limited experimental work where specially prepared microscope slides were used, degree of atomization was estimated arbitrarily from the glass plates. Streaks or large blotches indicated that atomization should be finer.

These glass plates were fragile, heavy and cumbersome to handle in the woods, and required special carrying cases to prevent breakage and damage to the sprayed surfaces. They were used, however, on forest insect control operations against the gypsy moth, tussock moth, spruce budworm and other pests until about 1952 because there was no good substitute for them until dyed cards were developed.

DEPOSIT EVALUATION METHODS

The colorimetric or dye tracer method was used early for quantitative measurements of aerial spray deposits. We believe that this method was developed by the Chemical Warfare Service about the time of World War II and adapted by various workers for use in research on mosquito control, agricultural and forest spraying.

At the Beltsville, Maryland, Forest Insect Laboratory, Davis (1)[2] used one pound of duPont oil-soluble Oil Red dye[3] in 50 gal. of spray for applications to be made at the rate of one gpa (gallon per acre). Samples of the falling spray were collected on two 6-X 6-in. glass (later aluminum) plates at each sampling station along a line approximately at right angles to the line of flight of the plane. These plates were washed off and a sample of the washings placed in a spectrophotometer to measure the intensity of light transmission through it. From comparisons with readings of samples from known dilutions, quantitative values were established for the deposit at each station. This procedure was used primarily for test flights over open ground to determine spray distribution patterns from various planes and types of spray equipment. To a limited extent it was also used for some experimental field applications. Changes were made in this technique to adapt it for use with dual spray apparatus (2) (12).

Dual spray apparatus consists of two separate complete spray systems on a single plane. It permits test flights under identical meteorological conditions for comparing the performance of any two different nozzle arrangements, types of nozzles, degrees of atomization, etc. One test condition is set up on one of the systems and a different one on the other. Different dyes are used in the liquid of each system. Spray is released simultaneously from both systems. A sample of the washings from the plates at each station is then exposed in a sensitive spectrophotometer to two different specific wave lengths - one for each dye. The quantity of spray deposited by each system at any station can be calculated from the quanity of dye recorded by this means. This method is currently used at the Beltsville Forest Insect Laboratory for comparison flights with dual sprayers.

Disadvantages of the dye tracer technique include the considerable time and personnel required to handle the sampling procedures and complete the calculations Since the dyes are subject to fading, tests are usually conducted in the early morning or late evening to reduce exposure of the samples to sunlight. In dual sprayer tests, it is essential to provide for as much separation as possible between the sensitive wave lengths of the two dyes.

The dye tracer technique is not practical for large control operations and the disadvantages of using glass plates has been pointed out above. In one or two instances the Canada Department of Agriculture used dye in the spray and collected samples of the spray on filter paper and special heavy weight white paper. The cost and mechanics of adding dye to hundreds of thousands of gallons of spray for large control operations was prohibitive.

2/ Numbers in parentheses refer to appended references.

3/ The mention of trade names or commercial companies in this paper does not imply endorsement of any particular produce or commercial concern.

The possibilities of reversing this procedure, or putting the dye on the sampling surface instead of in the spray, was investigated jointly by the Canada Department of Agriculture and United States Department of Agriculture. Davis and Elliott (6) found that an oil-sensitive paper sampling surface 4/ could be used to collect samples of oil sprays after it had been treated with an oil-soluble red dye (17). When oil spray droplets fall on the cards, the dye is dissolved and lighter colored circular spots with dark colored perimeters are formed.

The quantity of spray on cards can be estimated by comparison with cards having known quantities of spray (3). Primarily, these cards provide a field method for checking the adequacy of spray coverage in control programs; however, they have also been used extensively to determine the spray distribution characteristics of commercial aircraft offered for contract control operations. They are easy to use and provide a permanent record which can be retained for future reference.

Quantitative estimates of the spray deposit are necessarily biased by judgement of the individual making the comparative readings. These errors can be partially overcome by having at least two different persons read the cards and then average the results. Even though these cards are subject to fading by sunlight they can be used after having been in the field for 2 or 3 days. When reading the cards there is a tendency to underestimate the deposit unless the maximum diameter of the outside darker colored circle is considered instead of only the lighter colored central spot. The paper cards may be damaged by rodents, and dew or rain will collect on the upper side of cards unless some type of special elevated card holder providing a slightly convex surface is used (9). These dye-coated cards are still being used on many control projects as an indicator of adequacy of coverage; also for their psychological effect on contract operators when they realize that their work is being checked.

Lack of contrast between the drop spots and the paper cards, and the failure of red-dyed cards to show spots when drops were less than 40 microns in diameter, prompted studies to improve the dyed card technique, particularly for use in research. The Suffield Experimental Station of the Canada Defence Research Board later collected samples of red-dyed oil sprays on white "Printflex Cover" cards and reported this method to be quite satisfactory (7).

Maksymiuk (10) found that Sudan Black dye 5/, when used at the rate of 2 lbs. to 50 gals. of fuel oil No. 2, provided excellent contrast when collected on white "Kromekote Cover" cards. As a result, standards for visual comparisons were developed to replace the red-dyed card standards for certain experimental spray distribution studies at Beltsville. This was done by collecting samples of the falling dyed

4/ Printflex Cover, Mead Paper Corporation, Chillicothe, Ohio and later Kromekote Cover 65 lb., Champion Paper and Fiber Co., Hamilton, Ohio

5/ General Dyestuff Division, General Analine and Film Corp.

spray on both aluminum plates and white cards placed side by side at intervals across a spray swath. The quantity of spray on the aluminum plates was determined by use of an optical colorimeter, using a technique developed by Secrest (14). Quantitative values determined in this manner were assigned to the paper cards which had been placed adjacent to the aluminum plates. The cards with deposits from 0.1 to 1 gpa were then sorted into groups with 0.1 gpa difference between each group; and those from 1 to 2 gpa into groups with 0.25 gpa difference. A representative card from each group was selected for the standards.

This black-dye technique resulted in an increase in accuracy of estimating deposits because the spot outlines were more distinct; and because spots made by drops as small as 7 microns were visible. There was greater contrast between the spots and background with the black-dyed spray on white cards than with the older red-dyed cards. The percent of the spray released from the aircraft that was recovered on the ground was about 75 percent when using the black-dyed spray on white cards as compared to 50 percent when using the red-dyed cards. As a comparison, the average recovery obtained with the dye tracer method is about 80 percent.

The estimates of spray deposit are somewhat less accurate as the deposit rate increases to more than one-half gallon per acre, due to overlapping and spreading of the drops on the paper. In forest insect control this is not too important because minimum effective rates are generally less than one-half gallon per acre. Thus, for most equipment performance tests the use of black-dyed spray on white cards provides sufficient accuracy for practical purposes.

ATOMIZATION EVALUATION METHODS

The size of spray particles or the degree of spray atomization is measured in microns (25.4 microns = .001 in.). At the Beltsville Laboratory this measurement is expressed as mmd (mass median diameter). The mmd is the drop diameter that separates the spray volume into two equal parts; that is, half the volume is in drops larger than this diameter and half is in drops that are smaller.

The method used originally at the Beltsville Laboratory for recording size of spray drops was described by Davis (4). It involved collecting samples of oil spray on microscope slides coated with an oleophobic film. The slides were photographed in the field soon after exposure to reduce evaporation losses. Spray drops on the slides were then measured and counted on a projection of the photographic negative. The area photographed by this method was only three square inches at each sampling station. About 24 man-hours were required for the photography, measurement, and computation of the drops secured on each flight. This slow tedious procedure seriously handicapped atomization studies and was abandoned when the red-dyed cards were developed in 1952.

The use of red-dyed cards for determination of spray atomization has been discussed by Davis and Elliott (6) and by Thornton and Davis (16). The latter described a method for sampling which involves the selection at random of a small number of mmd determinations and computation of the mean mmd. Two methods of selecting drops for measurement were used -- a constant area and a variable area method. The difference between these methods is that in the latter, the size of the area was varied approximately as the cube of the drop diameter being counted, so that large drops were sampled more intensively than small ones. This variable area method was further improved by Maksymiuk and Davis in 1956.

The cards provide a sample area of about 15 sq. in. at each station. The variable area method of selecting drops for measurement requires a total time per flight of about 6 man-hours for measurement and computation. This represents a saving of 75 percent over the photographic method. Substitution of the black-dyed spray on white cards for the red-dyed card method of sampling has further increased the accuracy and made the work easier. Drop outlines are more distinct and smaller diameter drops can be seen on the white cards.

During some of the research flights, the flow rate of the spray system has been reduced to one-third to one-fourth the normal rate to reduce overlapping of drop spots on the cards at sampling stations near the center of the swath. This reduction has also been accomplished by using special sampling devices consisting of paper covered rollers revolving beneath slotted cover plates.

Davis observed from drop measurement data that there seemed to be a relationship between mmd and diameter of the largest drop but it did not appear to be consistent for all conditions. Maksymiuk investigated this further and developed a "D-max" method of estimating mmd (10).

D-max is defined as the diameter of the largest drop spot, formed by spray falling on the paper cards, which is not more than 200 microns larger than the next smaller spot. Occasional spots more than 200 microns larger than D-max are eliminated from consideration in determining mmd. The mmd is estimated by the following formula:

$$\text{mmd} = \frac{\text{spot D-max}}{\text{spread factor X conversion factor}}$$

Spread factor must be determined for the particular spray and sampling surface used. When fuel oil No. 2 with Sudan Black dye (2 lbs. per 50 gal.) was used on white "Kromekote Cover" cards a spherical drop 128 microns in diameter spread until it made a spot 600 microns in diameter, or by a factor of 4.7. A 250 micron drop spread 6 times to a 1500 micron spot, and a 502 micron drop spread about 6.6 times to a 3300 micron spot.

Determination of the proper spread factor is the most critical step in the procedure for determining atomization by any method where the drops spread on the sampling surface, particularly paper. Therefore, some means of producing drops of uniform size in the laboratory is required. One such method has been described by Davis (5) and Rayner and Hurtig (13). Procedure for spread factor determination has been given in detail by Maksymiuk and Moore (11).

The conversion factor in the formula above was calculated from previously determined mmd's (by the variable area method described above) by dividing the spherical D-max by these mmd's. This is an arbitrary figure arrived at by starting out with a known (mmd) and working back to the conversion factor. A factor of 2.2 has been used for medium atomizations with Piper, Stearman, and similar speed aircraft.

It is estimated that mmd determinations can be made with about 90 percent saving of time by the D-max method instead of the variable area method, with no sacrifice of accuracy. The D-max method appears to be reliable for oil sprays collected on paper cards when the atomization is in the medium range (100 to 250 microns mmd). Up to the present time it has not been used for very fine or extremely coarse sprays.

Since only the largest drops are used in the D-max method, a light crosswind, up to about 6 mph, is preferred for the test flights. This sorts the drops so that the largest ones are on the upwind end of the line of sampling cards. It also reduces overlapping of drops to a minimum without having to reduce the flow rate.

POSSIBILITIES FOR IMPROVEMENTS IN METHODS

The use of fluorescent tracers offers an excellent opportunity to simplify and improve deposit distribution assessments (8). At the Beltsville Forest Insect Laboratory, Secrest has started an investigation of the equipment and procedures most suitable for use in forest spraying research (15).

So far, Fluorol 7 GA (General Dyestuff) in oil sprays has been collected on white cards or aluminum plates and the deposits measured by a photomultiplier microphotometer. We hope to be able to use this method of measurement for dual spray equipment experiments by proper selection of chemicals and filters.

This oil-soluble fluorescent material has also been used, to a limited extent, in sprays on control operations. Here distribution of the spray was observed by a portable ultra-violet light. Using this material, observations must be made at night unless a hood is used. A water soluble fluorescent material, Leucophor C (Sandoz), has been used in water-based virus sprays which can also be observed by an ultraviolet light.

So far, water sprays and dry materials have seldom been used in aerial applications for forest insect control. There is a possibility that this situation may be reversed in the coming years. For example, there is considerable interest now in the use of viruses and other biological materials for this purpose, and it may be necessary to apply them in the form of water sprays. In the future, therefore, methods must be developed or adapted to assess water sprays as well as dry materials.

Simple and fairly accurate methods for the assessment of coverage and drop size are essential for continued improvement in application equipment performance.

REFERENCES

1. Davis, J. M. Methods of studying deposition of aerial sprays, 1946 season. Unpublished progress report. Forest Insect Laboratory, Beltsville, Md. 1947.

2. Davis, J. M. Methods of studying deposition of aerial sprays, 1950 season. Unpublished progress report. Forest Insect Laboratory, Beltsville, Md. 1951.

3. Davis, J. M. Standards for estimating airplane spray deposits on oil-sensitive cards. Forest Service unnumbered booklet. 1954.

4. Davis, J. M. A photographic method for recording size of spray drops. U. S. Department of Agriculture, ET-272, Forest Insect Laboratory, Beltsville, Md. July 1949.

5. Davis, J. M. A vibratory apparatus for producing drops of uniform size. U. S. Department of Agriculture, ET-295, Forest Insect Laboratory, Beltsville, Md. April 1951.

6. Davis, J. M. and Elliott, K. R. A rapid method of estimating aerial spray deposits. J. Econ. Ent., 46(4):696-698, August 1953.

7. Hurtig, H., Mann, S. L. W., Hopewell, W. W., and Gravelles, R. A new technique for sampling and assessing aerial spray deposits. Can. Jour. Agr. Sc., 36(2):81-94, 1956.

8. Liljedahl, L. A. and Strait, John. Spray deposits measured rapidly. Agr. Engr. 40(6):332-335. June 1959.

9. Maksymiuk, Bohdan. Improved holders for spray deposit assessment cards. Jour. Econ. Ent., 52(5):1029-1030, October 1959.

10. Maksymiuk, Bohdan. A rapid method for determining atomization of oil base, aerial sprays. To be published in Jour. of Econ. Ent.

11. Maksymiuk, Bohdan and Moore, A. D. Spread factor variation for oil-base, aerial sprays. In Press. Jour. of Econ. Ent. 1962.

12. Miller, J. M. and Isler, D. A. Dual spray equipment for airplane spraying tests. Et-294, BE&PQ, ARA, USDA, 1951.

13. Rayner, A. C. and Hurtig, H. Apparatus for producing drops of uniform size. Science 120:672-673, Oct. 1954.

14. Secrest, J. P. Unpublished line project report FS-2-e3-9, Forest Insect Laboratory, Beltsville, Md. April 1961.

15. Secrest, J. P. Fluorescent materials as tracers in insecticides. Paper presented at Eastern Branch ESA, 1960.

16. Thornton, D. G. and Davis, J. M. A method of sampling for the drop size of aerial spray deposits. Jour. Econ. Ent. 49(1):80-83. Feb. 1956.

17. White, H. W. How to make oil-sensitive cards for estimating airplane spray deposit. Unnumbered publication. Forest Service, USDA. June 1959.

UNITED STATES DEPARTMENT OF AGRICULTURE

Forest Service

Division of Forest Insect Research

Forest Insect Laboratory, Beltsville, Maryland 1/

NOTES ON SOME ITEMS INVOLVED IN CHECKING CONTRACT SPRAY PLANES

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April, 1958

In the process of inspecting contractor's spray planes for a control job it is necessary to (1) calculate the flow rate required for the desired application rate, (2) determine the flow rate of planes being used, and (3) check the adequacy of dump valves and spray tank vents.

There aie of course many other items involved in a complete inspection job, but only the three points mentioned above are included in the following discussion.

1/ In cooperation with ARS, Agricultural Engineering Research Division

Flow Rate Calculations

Two formulas commonly used to calculate flow rate required from spray planes are:

$$F = \frac{SWD}{495} \quad \text{or} \quad F = .00202\ SWD$$

When:

F = flow rate required in gallons per minute

S = speed of plane in miles per hour

W = width of swath in feet

D = application rate in gallons per acre

The $\frac{1}{495}$ or .00202 is a constant representing the portion of an acre covered in 1 minute at 1 mph with a swath width of 1 foot.

For all practical purposes and to simplify the calculations in the formulas above, 500 may be substituted for 495 and .002 for .00202. This simplification decreases the flow rate by only on percent which is insignificant. As simplified these formulas become:

$$F = \frac{SWD}{500} \quad \text{or} \quad F = .002SWD$$

Example - Determine the flow rate required to apply 1 gallon per acre over a swath width of 500 feet from a plane flying 150 mph.

$$F = .002 \times 150 \times 500 \times 1$$

$$= 150 \text{ gpm}$$

Occasionally a spray plane will come on the job with pumping equipment which will not deliver the required flow rate. In such cases the flow rate of the plane is inserted in the formula as a known factor and the swath as unknown to determine the swath width to assign to the plane. For example, assume a DC-3 would normally be allowed a 500-ft. swath. At 150 mph for 1 gpa the flow rate should be 150 gpm. A calibration check shows that this plane will deliver only 120 gpm. The swath width must then be reduced. To determine the new swath width we calculate;

$$F = .002SWD$$

$$\text{then, } 120 = .002 \times 150 \times W \times 1$$

$$120 = .300W$$

$$W = \frac{120}{.300}$$

$$= 400 \text{ feet, the new swath}$$

Calibration Procedure

The object of the calibration procedure is, of course, to determine the flow rate of the plane. The first requirement is to make certain that the pump is primed and liquid lines are filled. Particularly in large planes, the tanks may be shaped or located so that the spray will not all drain down into the pump. Instances have been noted where a plane has a deadhead load of as much as 100 gallons.

To insure proper priming of the spray system (1) put sufficient liquid in the tank to prime the pump (2) take off and fly the plane in a straight and level flight at normal speed (3) open the spray valve and as soon as the spray pressure starts to drop <u>immediately</u> close it to prevent air being drawn into the system, and (4) land the plane.

Following this (1) meter into the tank sufficient liquid to provide a spray time of at least two minutes (2) again in flight leave the spray valve open until the pressure starts to drop, recording the "open valve time" with a stop watch, and (3) calculate gallons per minute by the formula:

$$\text{gpm} = \frac{\text{gals. metered into tank}}{\text{"open valve" time in minutes}}$$

For example, 210 gals, were metered into the tank and 3 minutes of "open valve" time were recorded. The flow rate was

$$\frac{210}{3} = 70 \text{ gpm.}$$

If the flow rate is within 5 percent of that desired it is usually not practical to make changes. Duplicate measurements should be made if time permits.

When the spray pump is driven by a gasoline engine the calibration may be carried out on the ground. With wind or hydraulic drives the plane should be flown to insure that full pump pressure is attained. Some hydraulic drives may permit ground procedure but usually not.

These preliminary measurements should always be verified on the job by timing with a stop watch the spray time required for a full load of spray. This can be done most accurately using the second plane load of spray rather than the first to insure that the system is primed and "dead-head" load, if any, established. Flow rate checks should be made as the control job progresses to discover any changes in adjustment of pressure, clogged nozzles, etc. The full load calculation is preferred over limited load when conditions permit.

If the flow rate is too high, some nozzles should be removed. When it is too low, nozzles should be added. If pump capacity is limited or the booms are too small to carry the gallonage without high friction losses, the addition of nozzles may not increase the flow. In these cases the swath must be reduced to conform to flow rate.

Dump Valves and Tank Vents

Emergency load dumping devices are required in control contracts. The size is usually specified as a ratio between load in gallons and area of dump valve in square inches. In 1957 in Region 1, it was 7.65 to 1 for single-engine planes and 9.6 to 1 for multi-engine planes. If a plane does not meet the specification the load should be reduced to conform to the area.

For example, a multi-engine spray plane has a tank capacity of 1,000 gals. and a dump valve area of only 80 sq. in.

$$\frac{9.6}{1} = \frac{L}{80}$$

$$L = 9.6 \times 80$$

$$= 768 \text{ gals., the allowable load.}$$

Tanks must be adequately vented so as not to restrict the flow through the dump valve. On the basis of tests with a Stearman having a 5-in. diameter dump valve, with 150 gallons in the tank, a 1½" diameter thin wall tubing vent was restrictive. The dump rate was 490 gpm. There was no restriction in the dump rate when a 1 3/4" o.d. tubing vent was used. The dump rate then was 600 gpm.

Using the above data it appears that a ratio of area of dump valve in sq. in. to area of vent in sq. in. should be not greater than 9 to 1. Although no tests have been made with large tanks, ratios somewhat greater than this could be tolerated because the friction loss in large vents will not be directly proportional to that in small vents. There can be no firm rule on this until additional data are available. It can be determined whether or not the vent is restrictive by timing the dumping of a load of water on the ground with tank cap on and one with the cap off to give additional venting. On some planes the dump valve may be considerably larger than that required by the "load to dump valve area" ratio. In that case, the vent size should be based on the minimum dump valve area that would meet the specifications. There is a possibility that a greatly restricted vent could cause damage to the tank by the rapid changes in internal pressure.

A RAPID METHOD FOR ESTIMATING THE ATOMIZATION OF AERIAL SPRAYS

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Atomization of aerial sprays is an important factor influencing the pattern of deposit distribution and coverage. Therefore, some measure of atomization is essential in aerial spraying research and for checking equipment on spray projects.

In our laboratory, working with oil-base sprays, mass median diameter (mmd) has been selected as an expression of atomization. The mmd is the drop diameter dividing the spray volume in two equal parts - 50% of the volume falls in drop sizes below mmd and 50% falls above mmd.

The mmd is most commonly determined by sampling the drop spectrum at regular intervals across the spray swath with paper cards and measuring each drop on a given unit area at different stations (Fig. 1).

Dyed spray on undyed card | Undyed spray on dyed card

Fig. 1. Spray deposit on kromekote paper

Determination of mmd is very time consuming because it requires an accurate sampling and measurement of all drop sizes. Inasmuch as the smaller drops drift for some distance from the flight line and are greatly influenced by wind and temperature gradient, it is necessary to run the flights under ideal meteorological conditions. Even when there is almost no wind it is necessary to set out long sampling lines to obtain a sample of the entire drop spectrum.

It has been found that the largest drops recovered are good indicators of atomization, thus they can be used for estimating mmd. On the basis of this finding the following procedure was developed for estimating the mmd.

1. The spots from the 5 largest drops collected across the swath are measured to the nearest 100 microns and tabulated in order of magnitude. From these one spot drop size is designated as D-max. D-max is the largest drop diameter with not more than 200 microns difference between it and the next smaller spot. Excessively large spots above D-max often indicate leaks or drool (Table 1).

Table 1. Selection of spot D-max

5 largest drop spots	drop spot diameter, microns
1.	2700
2.	2400 --- D-max
3.	2300
4.	2200
5.	2200

2. After measuring spot D-max it is necessary to convert it to spherical drop size and to divide by an appropriate conversion factor to arrive at the estimated mmd.

Spherical drop D-max is obtained by dividing the spot D-max by a spread factor. The spread factor tells us how many times a spray drop spreads on the sampling surface. Larger drops spread proportionately more than small drops.

The spread factor is determined in advance for each drop size, sampling surface and spray. This is done by producing drops of known size and dividing the spot they produce on the sampling surface by the actual spherical drop size. The following formula illustrates this:

$$\text{Spread factor} = \frac{\text{spot diameter on sampling surface}}{\text{corresponding spherical drop diameter}}$$

3. Finally, to convert spherical drop D-max to estimated mmd it is necessary to develop a conversion factor. The conversion factor is developed from previously measured mmd's by dividing the spherical D-max by the measured mmd (Table 2).

Table 2. Development of conversion factor from spherical D-max to estimated mmd

Number of flights	Mean spherical		Mean conversion factor
	D-max (microns)	measured mmd (microns)	$\left(\frac{\text{D-max}}{\text{meas. mmd}}\right)$
23	321	147	2.2 ± .08 1/

1/ Standard error of the mean at the 5% probability level.

The data in Table 2 are based on flights with slow speed planes (80 mph). Preliminary indications are that the conversion factor for high speed planes (150 - 180 mph) will be somewhat higher (approximately 2.5).

Estimated mmd is determined by the following formula:

$$\text{Estimated mmd} = \frac{\text{spot D-max}}{\text{spread factor x conversion factor}} \text{ or } \frac{\text{spherical D-max}}{\text{conversion factor}}$$

This formula was applied to 152 flights and it was found that there was no significant difference between estimated and measured mmd at the 1% probability level. The correlation coefficient was + .94. For a single flight, the difference between the estimated and the measured mmd is within $\pm$ 15% at the 5% probability level. When replicate flights are averaged accuracy is increased to about 10% or less.

This new method has the following advantages over the method of measuring mmd:

1. Since only large drops need to be assessed, meteorological conditions are not as restrictive (wind can be tolerated up to 8 mph, and tests can be conducted at any temperature gradient).

2. Shorter sampling lines are adequate (about 3 times the wing span of the airplane).

3. This method is simpler - requiring less highly trained personnel.

4. It is much faster and cheaper requiring about 20 minutes, while at least 1-man day is needed for measured mmd. (Saves more than 90% of time).

Because of these advantages this method is especially valuable in the field where the direct measurement of mmd is impractical.

APPENDIX E

BASIC DATA

MEMORANDUM 5 July 1962

Following data phoned in by Lt. Colonel Thompson on 2 July 1962 at 1530 hours:

Purple viscosity

25°C	36.60 centistokes
30°C	26.42
35°C	19.43

Surface tension at 28°C 37.8 dynes/cm

Interfacial tension with water at 28°C 23.4 dynes/cm

Specific gravity 1.28 at 25°C

/s/ C. E. Minarik
C. E. MINARIK
Chief, Crops Division

Copy furnished:
Dr. J. W. Brown
Mr. W. B. Johnson
Mr. L. W. Boyer
Sp-5 J. R. Frank
Pfc. R. E. Buschmann

CONSOLIDATED SUMMARY
Swath Width (ft)

Flt	Alt	Date	Type	Total	0.5 GPA	1.0 GPA	1.5 GPA	GPM	MMD	Material	% Recovery
1	150	24 Jun 62	Crosswind	940	800	400	300	180	247	Purple	-
2	150	24 Jun 62	Crosswind	1200	460	360	200	180	293	Purple	-
3	150	24 Jun 62	Crosswind	1740	840	320	240	180	253	Purple	-
4	150	24 Jun 62	Crosswind	1960	460	140	140	180	250	Purple	-
		25 Jun 62	Abort Due To Aircraft Maintenance								
1	150	26 Jun 62	Crosswind	1340	320	0	0	180	207	2 FO,1P	-
2	150	"	Inwind	940	420	0	0	180	233	"	70.7
3	150	"	Inwind	1020	480	80	40	180	226	"	74.3
4	150	"	Inwind	840	320	300	60	180	233	"	43.6
5	150	"	Crosswind	1780	620	200	0	180	213	"	-
6	150	"	Inwind	1340	420	280	60	180	247	"	57.8
1	150	27 Jun 62	Inwind	1040	600	300	260	206	300	Purple	128.2
2	150	"	Inwind	1500	400	300	300	206	293	"	89.0
3	150	"	Inwind	440	280	260	260	206	306	"	98.5
4	150	"	Inwind	560	360	340	280	206	307	"	113.3
5	150	"	Inwind	1520	500	320	280	206	300	"	128.5
6	150	"	Crosswind	2000	500	320	280	206	300	"	-
		28 Jun 62	Pilot Evaluation Tests								
		29 Jun 62	Abort Due to Weather								
		30 Jun 62	Equipment Malfunction								
1	150	1 Jul 62	Inwind	540	470	370	270	196		Purple	127.8
2	150	1 Jul 62	Inwind	1500	400	300	270	196		"	135.7
3	150	"	Crosswind	1660	560	400	370	196		"	-
4	150	"	Inwind	1560	420	400	360	196	293	"	162.9
1	150	2 Jul 62	Inwind	1400	700	360	140	192		Purple	123.2
2	150	"	Inwind	960	380	260	260	192		"	96.0
3	200	"	Inwind	1300	660	400	340	192		"	150.2
4	150	"	Crosswind	Wind Shift - Abort				192		"	-
5	150	"	Inwind	1020	660	460	320	192		"	173.9

CONSOLIDATED SUMMARY
Swath Width (ft)

Flt	Alt	Date	Type	Total	0.5 GPA	1.0 GPA	1.5 GPA	GPM	MMD	Material	% Recovery
1	150	3 Jul 62	Inwind	1020	440	300	280	197		Purple	108.1
2	200	"	Inwind	1440	600	380	320	197	320	"	83.3
3	150	"	Inwind	1060	480	340	300	197		"	90.2
4	150	"	Inwind	880	260	260	240	197		"	84.9
5	150	"	Crosswind	1760	900	240	220	197		"	--
1	200	4 Jul 62	Crosswind	1540	700	400	380	194		Purple	-
2	150	"	Inwind	480	260	240	200	194		"	86.5
3	150	"	Inwind	580	320	240	220	194		"	91.1
4	150	"	Inwind	1120	300	240	220	194		"	71.0
5	150	"	Inwind	1380	300	280	220	194		"	84.5
6	200	"	Crosswind	1920	900	580	280	194	333	"	-
1	200	5 Jul 62	Inwind	1040	380	260	260	197		Purple	98.5
2	150	"	Inwind	1220	700	420	320	197	313	"	91.1
3	150	"	Inwind	860	540	340	280	197		"	121.0
4	150	"	Inwind	840	420	380	320	197		"	114.0
5	150	"	Inwind	940	340	280	240	197		"	100.0
6	150	"	Crosswind	1340	400	380	340	197		"	-
1	150	6 Jul 62	Inwind	760	320	240	240	179		Purple	72.4
2	200	6 Jul 62	Inwind	1060	420	280	260	179		"	109.4
3	150	"	Inwind	740	320	240	240	179		"	100.5
4	150	"	Inwind	1300	440	220	220	179		"	109.8
5	150	"	Inwind	1200	420	220	220	179		"	100.5
6	150	"	Crosswind	1500	460	260	240	179		"	-
7	200	"	Crosswind	1540	500	300	240	179	320	"	-
8	250	"	Crosswind	1920	360	280	240	179	353	"	-
		7, 8, 9 Jul 62	Aircraft Maintenance								
1	150	10 Jul 62	Inwind	820	420	240	0	153		2 PO, 1P	82.3
2	150	"	Inwind	1360	280	260	0	153		"	56.8
3	150	"	Inwind	1340	340	280	20	153		"	52.0
4	150	"	Inwind	1160	280	220	40	153		"	54.3
5	150	"	Crosswind	2000	520	60	0	153	213	"	-

CONSOL__ATED SUMMARY
Swath Width (ft)

Flt	Alt	Date	Type	Total	0.5 GPA	1.0 GPA	1.5 GPA	GPM	MMD	Material	% Recovery
1	150	11 Jul 62	Crosswind	1820	880	300	0	150	213	Fuel Oil	-
2	150	"	Inwind	960	720	400	0	150		"	103.0
3	150	"	Inwind	2000	760	100	0	150		"	133.7
4	150	"	Inwind	1040	740	120	0	150		"	131.3
5	200	"	Crosswind	1940	560	20	0	150	213	"	-
6	150	"	Abort - Due to wind shift								

STUDY NOZZLE SPACING AND A

Test No.: 10 Date Calibrated: 25 June 1962 Date Test Flown: 24 June 1962

Material Used: Purple Calibrated Flow Rate. [illegible] GPM

Nozzle Information

Ident	Qty	Description	Location
o			
+	70	1/4" 6135 S.S. Check valve body only	1 thru 35
Total	70		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

+ +

Engine throttle position: [illegible]

System pressure at engine; spraying. [illegible] psi

Length of test run: 45 seconds Gallons pumped: 140

Remarks: Test flown 24 June 1962

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 24 June 1962

ALTITUDE: 150 feet

FLIGHT #: 1 ; Crosswind

SWATH WIDTH: 940 feet

SAMPLE LINE: D

AIRCRAFT COURSE: 225 degrees

TIME OF RELEASE: 0452 hours

DURATION: seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.15	26	0.9				
2	0.175	27	0.9				
3	0.2	28	1.0				
4	0.15	29	1.2				
5	0.175	30	1.2				
6	0.4	31	1.5				
7	0.3	32	2.0				
8	0.25	33	2.2				
9	0.5	34	2.3				
10	0.475	35	2.45				
11	0.5	36	1.2				
12	0.5	37	1.2				
13	0.425	38	1.9				
14	0.5	39	1.6				
15	0.525	40	1.5				
16	0.45	41	1.7				
17	0.65	42	1.9				
18	0.55	43	2.2				
19	0.5	44	2.15				
20	0.6	45	1.8				
21	0.65	46	1.1				
22	0.725	47	1.0				
23	0.75	48	0.5				
24	0.8	49	-				
25	0.8	station 50-100 blank					

Total 45.45

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 24 June 1962 ALTITUDE: 150 feet

FLIGHT #: 2 ; crosswind SWATH WIDTH: 1200 feet

SAMPLE LINE: D AIRCRAFT COURSE: 225 degrees

TIME OF RELEASE: 0513 hours

DURATION: seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.150	26	0.35	51	1.3		
2	0.175	27	0.45	52	1.2		
3	0.2	28	0.4	53	1.1		
4	0.175	29	0.35	54	1.2		
5	0.2	30	0.50	55	1.1		
6	0.225	31	0.45	56	1.2		
7	0.225	32	0.55	57	0.95		
8	0.2	33	0.35	58	0.8		
9	0.25	34	0.45	59	0.5		
10	0.275	35	0.55	60	0.2		
11	0.35	36	0.4	61	..		
12	0.375	37	0.55	Station 62-100 blank			
13	0.4	38	0.8				
14	0.4	39	1.0				
15	0.425	40	1.8				
16	0.35	41	1.5				
17	0.325	42	1.4				
18	0.325	43	1.6				
19	0.3	44	1.7				
20	0.3	45	1.4				
21	0.4	46	1.3				
22	0.4	47	1.3				
23	0.3	48	1.3				
24	0.3	49	1.5				
25	0.25	50	1.3				

Total 40.075

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 24 June 1962

ALTITUDE: 150 feet

FLIGHT #: 3 ; Crosswind

SWATH WIDTH: 1740 feet

SAMPLE LINE: D

AIRCRAFT COURSE: 225 degrees

TIME OF RELEASE: 0532 hours

DURATION: seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.07	26	0.32	51	0.75	76	1.40
2	0.06	27	0.30	52	0.70	77	1.50
3	0.10	28	0.35	53	0.65	78	1.78
4	0.125	29	0.40	54	0.70	79	1.40
5	0.07	30	0.38	55	0.70	80	2.10
6	0.10	31	0.40	56	0.68	81	1.30
7	0.095	32	0.36	57	0.77	82	0.55
8	0.13	33	0.40	58	0.68	83	0.60
9	0.15	34	0.35	59	0.68	84	0.70
10	0.10	35	0.35	60	0.77	85	0.68
11	0.18	36	0.37	61	0.75	86	0.35
12	0.12	37	0.45	62	0.90	87	0.17
13	0.15	38	0.50	63	0.80	88	-
14	0.21	39	0.40	64	0.82	Station 89-100 blank	
15	0.20	40	0.50	65	0.91		
16	0.235	41	0.475	66	1.20		
17	0.25	42	0.45	67	1.20		
18	0.26	43	0.475	68	1.30		
19	0.23	44	0.55	69	1.70		
20	0.25	45	0.60	70	1.90		
21	0.215	46	0.57	71	1.90		
22	0.175	47	0.57	72	1.80		
23	0.25	48	0.60	73	1.60		
24	0.20	49	0.55	74	1.10		
25	0.30	50	0.67	75	1.05		

Total 54.125

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 24 June 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Crosswind

SWATH WIDTH: 1960 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0557 hours

DURATION: seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.02	26	0.05	51	0.3	76	0.85
2	0.02	27	0.04	52	0.3	77	1.5
3	0.015	28	0.04	53	0.2	78	1.6
4	0.02	29	0.03	54	0.2	79	1.6
5	0.02	30	0.02	55	0.15	80	1.7
6	0.01	31	0.03	56	0.2	81	1.65
7	0.02	32	0.02	57	0.4	82	1.6
8	0.04	33	0.01	58	0.55	83	1.5
9	0.05	34	0.01	59	0.55	84	0.95
10	0.05	35	0.01	60	0.45	85	0.8
11	0.05	36	0.01	61	0.35	86	0.7
12	0.05	37	0.02	62	0.35	87	0.45
13	0.023	38	0.05	63	0.35	88	0.6
14	0.05	39	0.05	64	0.15	89	0.7
15	0.05	40	0.1	65	0.2	90	0.5
16	0.05	41	0.1	66	0.25	91	0.85
17	0.07	42	0.15	67	0.25	92	0.8
18	0.08	43	0.15	68	0.35	93	0.7
19	0.08	44	0.2	69	0.35	94	0.3
20	0.05	45	0.2	70	0.5	95	0.08
21	0.05	46	0.2	71	0.55	96	0.08
22	0.05	47	0.2	72	0.45	97	0.06
23	0.05	48	0.2	73	0.7	98	0.05
24	0.05	49	0.2	74	0.6	99	-
25	0.05	50	0.2	75	0.65	100	-

Total 32.325

SPRAY NOZZLE SPACING AND DATA

Test No.: 26 Date Calibrated: 25 June 1962 Date Test Flown: 26 June

Material Used: 2 parts fuel oil + 1 part Purple Calibrated Flow Rate: 181 GPM

Nozzle Information

Ident	Qty	Description	Location
o	68	3/16" 6135 S.S. Check valve body, only	7 thru 40
+			
Total	68		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Engine throttle position: Approx. 3/4 open

System pressure at engine; spraying: 23 psi

Length of test run: 30 seconds Gallons pumped: 90.5

Remarks: No chatter. Test flown 26 June

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 26 June 1962

ALTITUDE: 150 feet

FLIGHT #: 1 ; Crosswind

SWATH WIDTH: 1340 feet

SAMPLE LINE: D

AIRCRAFT COURSE: 045 degrees

TIME OF RELEASE: 0444 hours

DURATION: unknown seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.1	26	0.25	51	0.5		
2	0.1	27	0.3	52	0.6		
3	0.1	28	0.3	53	0.65		
4	0.1	29	0.25	54	0.55		
5	0.13	30	0.3	55	0.6		
6	0.15	31	0.35	56	0.55		
7	0.1	32	0.35	57	0.6		
8	0.13	33	0.35	58	0.6		
9	0.1	34	0.3	59	0.65		
10	0.1	35	0.35	60	0.7		
11	0.1	36	0.35	61	0.6		
12	0.15	37	0.3	62	0.7		
13	0.15	38	0.3	63	0.7		
14	0.2	39	0.35	64	0.8		
15	0.2	40	0.4	65	0.02		
16	0.15	41	0.375	66	0.05		
17	0.25	42	0.45	67	0.03		
18	0.2	43	0.3	68	0.01		
19	0.25	44	0.35	69	0		
20	0.2	45	0.45	Station 70-100 blank			
21	0.2	46	0.5				
22	0.25	47	0.45				
23	0.25	48	0.55				
24	0.25	49	0.5				
25	0.3	50	0.45				

Total 22.295

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple
AIRSPEED: Constant at 150 mph (130 knots)
DATE: 26 June 1962
ALTITUDE: 150 feet
FLIGHT #: 2 ; Inwind
SWATH WIDTH: 940 feet
SAMPLE LINE: B
AIRCRAFT COURSE: 315 degrees
TIME OF RELEASE: 0509 hours
DURATION: unknown seconds
FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-51 blank				51	-	76	0.5
				52	-	77	0.55
				53	0.01	78	0.45
				54	0.3	79	0.45
				55	0.5	80	0.35
				56	0.4	81	0.4
				57	0.8	82	0.45
				58	0.7	83	0.4
				59	0.55	84	0.4
				60	0.65	85	0.35
				61	0.5	86	0.35
				62	0.6	87	0.35
				63	0.5	88	0.35
				64	0.8	89	0.3
				65	0.8	90	0.25
				66	0.9	91	0.23
				67	0.9	92	0.2
				68	0.9	93	0.22
				69	0.85	94	0.23
				70	0.95	95	0.24
				71	0.85	96	0.23
				72	0.8	97	0.22
				73	0.65	98	0.2
				74	0.65	99	0.18
				75	0.6	100	0.17

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 23.18 \times 18.13}{180} = 70.7$$

Total 23.18

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple — AIRSPEED: Constant at 150 mph (130 knots)

DATE: 26 June 1962 — ALTITUDE: 150 feet

FLIGHT #: 3 ; Inwind — SWATH WIDTH: 1020 feet

SAMPLE LINE: B — AIRCRAFT COURSE: 315 degrees

TIME OF RELEASE: 0530 hours

DURATION: unknown seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-50 blank				51	-	76	0.5
				52	0.45	77	0.55
				53	0.45	78	0.45
				54	0.6	79	0.45
				55	0.6	80	0.40
				56	0.5	81	0.50
				57	0.45	82	0.45
				58	0.6	83	0.45
				59	0.6	84	0.43
				60	0.85	85	0.4
				61	0.9	86	0.3
				62	1.2	87	0.3
				63	1.6	88	0.25
				64	2.1	89	0.2
				65	0.9	90	0.2
				66	0.7	91	0.2
				67	0.6	92	0.15
				68	0.6	93	0.13
				69	0.6	94	0.13
				70	0.65	95	0.12
				71	0.5	96	0.12
				72	0.5	97	0.1
				73	0.45	98	0.08
				74	0.5	99	0.07
				75	0.45	100	0.05

$$\% \text{ Recovery} \simeq \frac{.202 \times 150 \times 24.33 \times 18.13}{180} = 74.3$$

Total 24.33

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 26 June 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 840 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0553 hours

DURATION : unknown seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.005	26	0.5				
2	0.008	27	0.75				
3	0.01	28	1.1				
4	0.005	29	1.1				
5	0.005	30	0.9				
6	0.01	31	0.85				
7	0.01	32	0.9				
8	0.01	33	0.65				
9	0.02	34	0.6				
10	0.02	35	0.5				
11	0.04	36	0.35				
12	0.05	37	0.45				
13	0.08	38	0.6				
14	0.12	39	0.5				
15	0.15	40	1.5				
16	0.15	41	2.3				
17	0.17	42	2.5				
18	0.17	43	0.03				
19	0.2	44	-				
20	0.26	Stations 45 -100 blank					
21	0.26						
22	0.3						
23	0.35						
24	0.4						
25	0.4						

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 19.28 \times 20}{180} = 43.6$$

Total 19.28

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 26 June 1962

ALTITUDE: 150 feet

FLIGHT #: 5 ; Crosswind

SWATH WIDTH: 1780 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0617 hours

DURATION: unknown seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G. .A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	1.1	51	0.2		
2	"	27	1.0	52	0.2		
3	"	28	0.9	53	0.1		
4	"	29	0.9	54	0.1		
5	"	30	0.9	55	0.1		
6	"	31	0.9	56	0.08		
7	"	32	0.9	57	0.08		
8	"	33	0.9	58	0.08		
9	"	34	0.9	59	0.08		
10	-	35	0.9	60	0.06		
11	0.1	36	0.9	61	0.04		
12	0.3	37	0.9	62	0.04		
13	0.6	38	0.8	63	0.04		
14	0.6	39	0.8	64	0.01		
15	0.8	40	0.6	65	0.01		
16	0.9	41	0.6	66	0.01		
17	1.0	42	0.5	67	0.01		
18	1.0	43	0.3	68	0.01		
19	0.8	44	0.3	69	0.01		
20	0.7	45	0.3	70	0.01		
21	0.6	46	0.3	71	Trace		
22	0.7	47	0.3	Stations 72- 100 trace			
23	0.8	48	0.25				
24	0.7	49	0.25				
25	1.1	50	0.2				

Total 29.07

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 26 June 1962

ALTITUDE: 150 feet

FLIGHT #: 6 ; Inwind

SWATH WIDTH: 1340 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0635 hours

DURATION:: unknown seconds

FLOW RATE: 180 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	0.01	51	0.05	76	0.25
2	"	27	0.02	52	0.3	77	-
3	"	28	0.02	53	0.25	Station 78-100 blank	
4	"	29	0.03	54	0.22		
5	"	30	0.05	55	0.5		
6	"	31	0.07	56	0.78		
7	"	32	0.1	57	0.88		
8	--	33	0.1	58	0.9		
9	0.005	34	0.05	59	0.85		
10	0.02	35	0.04	60	0.9		
11	0.04	36	0.02	61	1.0		
12	0.06	37	0.03	62	0.85		
13	0.05	38	0.05	63	0.65		
14	0.06	39	0.04	64	0.4		
15	0.06	40	0.04	65	0.35		
16	0.05	41	0.03	66	0.03		
17	0.05	42	0.03	67	0.02		
18	0.06	43	0.02	68	0.05		
19	0.05	44	0.02	69	0.15		
20	0.07	45	0.03	70	0.2		
21	0.08	46	0.06	71	0.3		
22	0.05	47	0.1	72	1.9		
23	0.05	48	0.1	73	2.4		
24	0.04	49	0.1	74	1.3		
25	0.05	50	0.08	75	0.7		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 18.28 \times 18.79}{180} = 57.8$$

Total 18.275

[illegible]

Test No.: 34 Date Calibrated: 31 Jan 1966 Date Test Flown: 27 June

Material Used: Purple Calibrated Flow Rate: 206 GPM

Nozzle Information

Ident	Qty	Description	Location
o	16	3/8" 0135 S.S. Check valve ...	1 thru 21, 28 thru 37
+	8	1/4" 0135 S.S. " "	1 thru 4
Total	24		

Nozzle location, same on each boom, No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Engine throttle position: [illegible]

System pressure at engine, [illegible] 33 [illegible]

Length of test run 30 seconds Gallons pumped 103

Remarks. Test flown 27 June

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 27 June 1962

ALTITUDE: 150 feet

FLIGHT #: 1 ; Inwind

SWATH WIDTH: 1040 feet

SAMPLE LINE: B

AIRCRAFT COURSE: 315 degrees

TIME OF RELEASE: 0436 hours

DURATION: 21 seconds

FLOW RATE: 206 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-46 blank				47	-	74	0.6
				48	0.05	75	0.65
				49	1.6	76	0.6
				50	2.6	77	0.5
				51	2.7	78	0.55
				52	1.8	79	0.45
				53	1.2	80	0.375
				54	0.85	81	0.375
				55	1.7	82	0.4
				56	1.7	83	0.35
				57	2.6	84	0.35
				58	2.2	85	0.4
				59	2.3	86	0.325
				60	2.1	87	0.35
				61	1.9	88	0.3
				62	1.3	89	0.3
				63	1.4	90	0.3
				64	0.8	91	0.25
				65	0.8	92	0.25
				66	0.8	93	0.25
				67	0.7	94	0.2
				68	0.7	95	0.18
				69	0.7	96	0.15
				70	0.65	97	0.13
				71	0.55	98	0.09
				72	0.5	99	0.07
				73	0.6	100	0.05

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 43.595 \times 20}{206} = 128.2$$

Total 43.595

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 27 June 1962

ALTITUDE: 150 feet

FLIGHT #: 2 ; Inwind

SWATH WIDTH: 1500 feet

SAMPLE LINE: B

AIRCRAFT COURSE: 315 degrees

TIME OF RELEASE: 0454 hours

DURATION: 22 seconds

FLOW RATE: 206 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-25 Blank		26	3.8	51	0.35	76	0.02
		27	3.5	52	0.4	77	0.01
		28	2.4	53	0.4	78	0.01
		29	1.2	54	0.35	79	0.01
		30	0.9	55	0.3	80	0.01
		31	0.9	56	0.25	81	0.01
		32	1.2	57	0.25	82	0.01
		33	2.4	58	0.2	83	0.01
		34	2.5	59	0.2	84	0.01
		35	3.0	60	0.2	85	0.01
		36	3.4	61	0.15	86	0.01
		37	2.3	62	0.1	87	0.01
		38	2.0	63	0.08	88	0.01
		39	1.85	64	0.08	89	0.01
		40	1.75	65	0.07	90	0.01
		41	0.9	66	0.07	91	0.01
		42	0.75	67	0.07	92	0.01
		43	0.8	68	0.06	93	0.01
		44	0.8	69	0.05	94	0.01
		45	0.5	70	0.045	95	0.01
		46	0.45	71	0.04	96	0.01
		47	0.45	72	0.04	97	0.01
		48	0.35	73	0.03	98	0.01
		49	0.3	74	0.03	99	0.01
		50	0.3	75	0.02	100	0.01

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 42.8 \times 14.14}{206} = 89.0$$

Total 42.8

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 27 June 1962

ALTITUDE: 150 feet

FLIGHT #: 3 ; Inwind

SWATH WIDTH: 440 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0517 hours

DURATION: 18 seconds

FLOW RATE: 206 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-50 Blank				51	Blank	76	0.01
				52	"	77	0.01
				53	"	78	Blank
				54	"	Stations 79 -100 blank	
				55	0.01		
				56	0.01		
				57	0.03		
				58	0.08		
				59	0.09		
				60	0.15		
				61	0.8		
				62	2.5		
				63	2.75		
				64	3.5		
				65	3.5		
				66	3.2		
				67	2.0		
				68	2.1		
				69	1.2		
				70	1.25		
				71	1.4		
				72	2.5		
				73	3.6		
				74	4.9		
				75	0.04		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 35.63 \times 18.79}{206} = 98.5$$

Total 35.63

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 27 June 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 560 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0540 hours

DURATION: 16 seconds

FLOW RATE: 206 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-70 blank				71	-	96	0.25
				72	1.2	97	0.2
				73	4.8	98	0.2
				74	3.4	99	0.1
				75	2.3	100	0.08
				76	1.7		
				77	1.1		
				78	1.2		
				79	1.7		
				80	1.6		
				81	2.1		
				82	3.5		
				83	3.2		
				84	2.3		
				85	2.0		
				86	2.2		
				87	1.1		
				88	1.25		
				89	0.85		
				90	0.4		
				91	0.45		
				92	0.4		
				93	0.5		
				94	0.5		
				95	0.35		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 41.01 \times 18.79}{206} = 113.3$$

Total 41.01

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 27 June 1962

ALTITUDE: 150 feet

FLIGHT #: 5 ; Inwind

SWATH WIDTH: 1520 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0602 hours

DURATION: 17 seconds

FLOW RATE: 206 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-23 blank		24	-	49	0.5	74	0.01
		25	1.7	50	0.45	75	0.01
		26	4.7	51	0.36	76	0.01
		27	2.6	52	0.35	77	0.01
		28	2.1	53	0.28	78	Trace
		29	1.1	54	0.3	Stations 79-100 Trace	
		30	1.2	55	0.22		
		31	1.25	56	0.2		
		32	3.1	57	0.1		
		33	3.2	58	0.09		
		34	3.1	59	0.09		
		35	3.4	60	0.08		
		36	2.75	61	0.07		
		37	2.6	62	0.06		
		38	1.9	63	0.04		
		39	1.7	64	0.03		
		40	1.2	65	0.025		
		41	0.85	66	0.02		
		42	0.9	67	0.01		
		43	0.65	68	0.01		
		44	0.75	69	0.01		
		45	0.65	70	0.01		
		46	0.63	71	0.01		
		47	0.55	72	0.01		
		48	0.55	73	0.01		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 46.50 \times 18.79}{206} = 128.5$$

Total 46.50

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 27 June 1962

ALTITUDE: 150 feet

FLIGHT #: 6 ; Crosswind

SWATH WIDTH: 2000 feet

SAMPLE LINE: B

AIRCRAFT COURSE: 315 degrees

TIME OF RELEASE: 0635 hours

DURATION:: 17 seconds

FLOW RATE: 206 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	2.4	26	0.45	51	0.02		
2	2.3	27	0.4	52	0.02		
3	2.0	28	0.35	53	0.04		
4	1.4	29	0.25	54	0.01		
5	1.5	30	0.2	55	0.01		
6	2.4	31	0.2	56	0.01		
7	2.1	32	0.2	57	0.02		
8	2.2	33	0.2	58	0.02		
9	2.2	34	0.2	59	0.01		
10	2.1	35	0.2	60	0.01		
11	2.1	36	0.15	61	0.02		
12	2.0	37	0.2	62	0.02		
13	1.8	38	0.15	63	0.03		
14	1.8	39	0.15	64	0.02		
15	1.1	40	0.15	65	0.01		
16	1.2	41	0.15	66	0.02		
17	0.9	42	0.1	67	0.01		
18	0.9	43	0.1	68	0.01		
19	0.9	44	0.1	69	Trace		
20	0.8	45	0.1	Stations 70-100 Trace			
21	0.85	46	0.08				
22	0.85	47	0.09				
23	0.65	48	0.07				
24	0.6	49	0.01				
25	0.55	50	0.05				

Total 42.11

SPRAY NOZZLE SPACING AND DATA

Test No.: 35 Date Calibrated. 27 June 1962 Date Test Flown: 1 July

Material Used: Purple Calibrated Flow Rate: 198 GPM

Nozzle Information

Ident	Qty	Description	Location
o	56	3/4" 6135 SS Check valve body, only	1 thru 7, 10, 13 thru 21, 29 thru 4[illegible]
+	18	1/4" 6135 SS " " " "	1 thru 4, 37 thru 40
Total	74		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Engine throttle position: Wide open

System pressure at engine; spraying. 325 psi

Length of test run. 30 seconds Gallons pumped: 99

Remarks: Test flown 1 July

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 1 July 1962 ALTITUDE: 150 feet

FLIGHT #: 1 ; Inwind SWATH WIDTH: 540 feet

SAMPLE LINE: C AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0500 hours

DURATION: 14 seconds

FLOW RATE: 196 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-54 blank				51	Blank	76	1.5
				52	"	77	2.4
				53	"	78	2.3
				54	"	79	2.4
				55	Trace	80	2.2
				56	Blank	81	2.1
				57	"	82	2.5
				58	"	83	2.4
				59	"	84	2.2
				60	"	85	2.4
				61	"	86	2.2
				62	Trace	87	2.35
				63	"	88	2.4
				64	Blank	89	1.9
				65	"	90	1.2
				66	"	91	1.3
				67	"	92	1.0
				68	Trace	93	1.2
				69	Blank	94	1.0
				70	"	95	0.9
				71	"	96	0.8
				72	Trace	97	0.7
				73	Blank	98	0.8
				74	Trace	99	0.6
				75	Trace	100	0.5

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 41.25 \times 20}{196} = 127.8$$

Total 41.25

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 1 July 1962

ALTITUDE: 150 feet

FLIGHT #: 2 ; Inwind

SWATH WIDTH: 1500 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0519 hours

DURATION: 18 seconds

FLOW RATE: 196 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-25 blank		26	Trace	51	0.5	76	0.07
		27	"	52	0.4	77	0.06
		28	"	53	0.3	78	0.05
		29	" "	54	0.3	79	0.04
		30	Blank	55	0.3	80	0.01
		31	0.2	56	0.3	81	0.01
		32	3.2	57	0.2	82	0.01
		33	2.7	58	0.25	83	0.01
		34	3.1	59	0.2	84	0.01
		35	2.7	60	0.2	85	Trace
		36	1.4	61	0.1	Stations 86-100 trace	
		37	2.3	62	0.1		
		38	2.6	63	0.1		
		39	3.1	64	0.1		
		40	2.9	65	0.1		
		41	3.1	66	0.1		
		42	2.4	67	0.1		
		43	2.3	68	0.1		
		44	1.5	69	0.1		
		45	1.6	70	0.1		
		46	1.0	71	0.1		
		47	0.8	72	0.1		
		48	0.9	73	0.08		
		49	0.7	74	0.08		
		50	0.7	75	0.07		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 43.88 \times 20}{196} = 135.7$$

Total 43.88

MASS DEPOSIT

MATERIAL: Purple
AIRSPEED: Constant at 150 mph (130 knots)
DATE: 1 July 1962
ALTITUDE: 150 feet
FLIGHT #: 3 ; Crosswind
SWATH WIDTH: 1660 feet
SAMPLE LINE: B
AIRCRAFT COURSE: 315 degrees
TIME OF RELEASE: 0553 hours
DURATION: 17 seconds
FLOW RATE: 196 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	2.3	51	0.2	76	0.15
2	"	27	2.4	52	0.15	77	0.1
3	"	28	2.0	53	0.2	78	0.08
4	"	29	1.3	54	0.2	79	0.08
5	"	30	1.5	55	0.15	80	0.05
6	"	31	2.2	56	0.2	81	0.06
7	"	32	2.3	57	0.2	82	0.04
8	"	33	1.8	58	0.2	83	0.04
9	" "	34	1.7	59	0.2	84	0.04
10	"	35	2.2	60	0.25	85	0.02
11	"	36	1.1	61	0.3	86	0.01
12	"	37	1.0	62	0.3	87	0.01
13	"	38	0.9	63	0.3	88	Trace
14	"	39	0.7	64	0.3	89	"
15	"	40	0.6	65	0.3	90	"
16	"	41	0.7	66	0.2	91	"
17	Blank	42	0.6	67	0.2	92	"
18	1.5	43	0.5	68	0.2	93	0.01
19	1.5	44	0.5	69	0.3	94	0.01
20	1.6	45	0.5	70	0.3	95	0.05
21	1.2	46	0.4	71	0.3	96	0.05
22	1.5	47	0.3	72	0.3	97	0.04
23	1.7	48	0.2	73	0.3	98	0.03
24	1.8	49	0.2	74	0.1	99	0.02
25	2.1	50	0.2	75	0.15	100	0.02

Total 47.71

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 1 July 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 1560 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0617 hours

DURATION: 18 seconds

FLOW RATE: 196 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	2.8	51	0.25	76	0.1
2	"	27	2.2	52	0.25	77	0.1
3	"	28	3.1	53	0.3	78	0.09
4	"	29	3.3	54	0.3	79	0.09
5	"	30	2.7	55	0.35	80	0.1
6	"	31	2.4	56	0.3	81	0.1
7	"	32	2.3	57	0.3	82	0.08
8	"	33	2.7	58	0.4	83	0.08
9	"	34	1.8	59	0.3	84	0.09
10	"	35	2.1	60	0.35	85	0.09
11	"	36	2.4	61	0.35	86	0.08
12	"	37	2.0	62	0.2	87	0.07
13	"	38	2.3	63	0.1	88	0.06
14	"	39	1.1	64	0.1	89	0.05
15	"	40	1.9	65	0.1	90	0.04
16	"	41	1.8	66	0.1	91	0.03
17	"	42	1.2	67	0.09	92	0.04
18	"	43	0.9	68	0.09	93	0.04
19	"	44	0.4	69	0.09	94	0.04
20	"	45	0.3	70	0.08	95	0.03
21	"	46	0.25	71	0.07	96	0.03
22	-	47	0.3	72	0.08	97	0.02
23	0.9	48	0.25	73	0.08	98	0.01
24	1.5	49	0.2	74	0.07	99	Trace
25	3.2	50	0.2	75	0.1	100	Trace

% Recovery $= \frac{.202 \times 150 \times 52.68 \times 20}{196} = 162.9$

Total 52.68

SPRAY NOZZLE SPACING AND [illegible]

Test No.: 36 Date Calibrated. 1 July 1962 Date Test Flown: 2 July

Material Used. Purple Calibrated Flow Rate. 191 GPM

Nozzle Information

Ident	Qty	Description	Location
o	3[illegible]	⅜ 0.35 S.S. Check valve body, only	1 thru 7, 13 thru 21, 29 thru 40
+	11	¼ 0.35 S.S. " " " "	1 thru 4, 37 thru 40
Total	7[illegible]		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Engine throttle position: Wide open

System pressure at engine; spraying: 32 psi

Length of test run. 30 seconds Gallons pumped: 97

Remarks: Test flown 2 July. Same as test no. 35 with No 10 nozzle removed.

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 2 July 1962 ALTITUDE: 150 feet

FLIGHT #: 1 ; Inwind SWATH WIDTH: 1400 feet

SAMPLE LINE: D AIRCRAFT COURSE: 032 degrees

TIME OF RELEASE: 0455 hours

DURATION: 21 seconds

FLOW RATE: 192 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.03	26	0.1	51	0.8		
2	0.05	27	0.1	52	0.9		
3	0.03	28	0.1	53	1.0		
4	0.05	29	0.1	54	1.0		
5	0.05	30	0.1	55	1.1		
6	0.06	31	0.2	56	1.2		
7	0.08	32	0.2	57	1.0		
8	0.09	33	0.2	58	1.0		
9	0.09	34	0.4	59	1.1		
10	0.1	35	0.4	60	1.2		
11	0.1	36	0.3	61	1.2		
12	0.2	37	0.5	62	1.3		
13	0.1	38	0.4	63	1.4		
14	0.1	39	0.5	64	1.5		
15	0.1	40	0.6	65	1.4		
16	0.1	41	0.7	66	1.3		
17	0.2	42	0.7	67	1.4		
18	0.2	43	0.6	68	1.4		
19	0.1	44	0.8	69	1.5		
20	0.2	45	0.7	70	1.6		
21	0.1	46	0.8	71	0.5		
22	0.1	47	0.8	72	-		
23	0.1	48	0.7	Stations 73-100 blank			
24	0.2	49	0.7				
25	0.1	50	0.9				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 39.03 \times 20}{192} = 123.2$$

Total 39.03

MASS DEPOSIT

MATERIAL: Purple

DATE: 2 July 1962

FLIGHT #: 2 ; Inwind

SAMPLE LINE: C

TIME OF RELEASE: 0523 hours

DURATION: 16.5 seconds

FLOW RATE: 192 GPM

AIRSPEED: Constant at 150 mph (130 knots)

ALTITUDE: 150 feet

SWATH WIDTH: 960 feet

AIRCRAFT COURSE: 005 degrees

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Trace	26	0.4	Stations 51-100 blank			
2	"	27	0.3				
3	"	28	0.4				
4	"	29	0.4				
5	"	30	0.5				
6	"	31	0.6				
7	-"	32	0.7				
8	0.01	33	0.7				
9	0.01	34	0.85				
10	0.02	35	0.9				
11	0.02	36	2.0				
12	0.02	37	2.0				
13	0.03	38	2.2				
14	0.03	39	2.3				
15	0.04	40	2.6				
16	0.04	41	1.8				
17	0.05	42	1.6				
18	0.07	43	1.2				
19	0.08	44	0.9				
20	0.1	45	2.1				
21	0.1	46	2.3				
22	0.2	47	2.4				
23	0.3	48	2.7				
24	0.3	49	-				
25	0.3	50	-				

% Recovery = $\frac{.202 \times 150 \times 33.57 \times 18.13}{192} = 96.0$

Total 33.57

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 2 July 1962

ALTITUDE: 200 feet

FLIGHT #: 3 ; Inwind

SWATH WIDTH: 1300 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 010 degrees

TIME OF RELEASE: 0546 hours

DURATION: 18 seconds

FLOW RATE: 192 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.05	26	0.4	51	1.9		
2	0.05	27	0.4	52	1.9		
3	0.07	28	0.4	53	1.5		
4	0.08	29	0.4	54	2.0		
5	0.09	30	0.4	55	2.2		
6	0.09	31	0.4	56	2.1		
7	0.07	32	0.6	57	2.4		
8	0.08	33	0.6	58	2.0		
9	0.1	34	0.6	59	2.1		
10	0.1	35	0.5	60	1.7		
11	0.1	36	0.5	61	1.7		
12	0.2	37	0.5	62	1.2		
13	0.1	38	0.6	63	1.0		
14	0.2	39	0.5	64	0.9		
15	0.2	40	0.5	65	0.3		
16	0.2	41	0.8	66	-		
17	0.2	42	0.9	Stations 67-100 blank			
18	0.3	43	0.7				
19	0.3	44	1.2				
20	0.25	45	1.6				
21	0.25	46	1.6				
22	0.3	47	1.8				
23	0.2	48	1.8				
24	0.4	49	2.0				
25	0.4	50	2.0				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 50.62 \times 18.79}{192} = 150.2$$

Total 50.62

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 2 July 1962

ALTITUDE: 150 feet

FLIGHT #: 5 ; Inwind

SWATH WIDTH: 1020 feet

SAMPLE LINE: B

AIRCRAFT COURSE: 315 degrees

TIME OF RELEASE: 0638 hours

DURATION: 16.5 seconds

FLOW RATE: 192 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-47 blank		49	0.8	75	0.7		
		50	2.8	76	0.8		
		51	2.6	77	0.7		
		52	2.1	78	0.7		
		53	2.1	79	0.6		
		54	2.3	80	0.5		
		55	2.3	81	0.5		
		56	2.2	82	0.35		
		57	2.6	83	0.2		
		58	2.5	84	0.2		
		59	2.1	85	0.1		
		60	2.2	86	0.15		
		61	2.3	87	0.15		
		62	2.2	88	0.15		
		63	2.6	89	0.15		
		64	2.1	90	0.2		
		65	2.1	91	0.2		
		66	1.0	92	0.4		
		67	1.1	93	0.4		
		68	1.1	94	0.35		
		69	0.9	95	0.3		
		70	0.9	96	0.3		
		71	0.9	97	0.1		
		72	1.1	98	0.1		
		73	0.9	99	0.1		
		74	0.8	100	0.1		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 55.10 \times 20}{192} = 173.9$$

Total 55.10

SPRAY NOZZLE SPACING AND DATA

Test No.: 37 Date Calibrated: 2 July 1962 Date Test Flown: 3 July

Material Used: Purple Calibrated Flow Rate: 197 GPM

Nozzle Information

Ident	Qty	Description	Location
o	56	3/8" 6135 S.S. Check valve body, only	1 thru 7, 13 thru 15, 19 thru 21, 28 thru 72
+	16	1/4" 6135 S.S. " " " "	1 thru 4, 37 thru 40
Total	72		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Engine throttle position: Wide open

System pressure at engine; spraying: 32 psi

Length of test run: 30 seconds Gallons pumped: 98.5

Remarks: Test flown 3 July.

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 3 July 1962

ALTITUDE: 150 feet

FLIGHT #: 1 ; Inwind

SWATH WIDTH: 1020 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0452 hours

DURATION: 18.5 seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.01	26	0.2	51	2.7		
2	0.01	27	0.2	52	2.8		
3	0.02	28	0.3	53	-		
4	0.02	29	0.4	54	-		
5	0.02	30	0.4	Station 55-100 blank			
6	0.04	31	0.5				
7	0.04	32	0.5				
8	0.04	33	0.6				
9	0.04	34	0.7				
10	0.05	35	0.7				
11	0.05	36	0.8				
12	0.07	37	0.8				
13	0.07	38	1.0				
14	0.09	39	1.5				
15	0.08	40	1.9				
16	0.1	41	2.3				
17	0.1	42	2.2				
18	0.1	43	2.2				
19	0.1	44	1.6				
20	0.1	45	2.3				
21	0.1	46	1.9				
22	0.1	47	2.1				
23	0.1	48	1.7				
24	0.1	49	1.2				
25	0.2	50	3.5				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 38.75 \times 18.13}{197} = 108.1$$

Total 38.75

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 3 July 1962

ALTITUDE: 150 feet

FLIGHT #: 2 ; Inwind

SWATH WIDTH: 1440 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0528 hours

DURATION: 16 seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Trace	26	0.08	51	0.7		
2	"	27	0.1	52	0.9		
3	"	28	0.1	53	1.0		
4	"	29	0.1	54	1.4		
5	Trace	30	0.1	55	1.3		
6	0.01	31	0.2	56	1.5		
7	0.01	32	0.2	57	1.7		
8	0.01	33	0.1	58	1.9		
9	0.01	34	0.2	59	2.0		
10	0.01	35	0.25	60	2.1		
11	0.01	36	0.2	61	1.8		
12	0.02	37	0.15	62	1.8		
13	0.02	38	0.2	63	1.9		
14	0.01	39	0.3	64	1.9		
15	0.02	40	0.2	65	1.6		
16	0.04	41	0.2	66	1.7		
17	0.05	42	0.4	67	1.9		
18	0.06	43	0.5	68	2.5		
19	0.05	44	0.5	69	2.4		
20	0.07	45	0.4	70	2.0		
21	0.09	46	0.6	71	2.8		
22	0.07	47	0.9	72	0.1		
23	0.06	48	0.7	73	-		
24	0.08	49	0.8	74 - 100 blank			
25	0.07	50	0.8				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 44.96 \times 12.04}{197} = 83.3$$

Total 44.96

MASS DEPOSIT

MATERIAL: Purple

DATE: 3 July 1962

FLIGHT #: 3 ; Inwind

SAMPLE LINE: B

TIME OF RELEASE: 0549 hours

DURATION: 19 seconds

FLOW RATE: 197 GPM

AIRSPEED: Constant at 150 mph (130 knots)

ALTITUDE: 150 Feet

SWATH WIDTH: 1060 Feet

AIRCRAFT COURSE: 315 degrees

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1 - 44 blank		45	-	70	0.4	95	0.01
		46	-	71	0.5	96	0.01
		47	0.1	72	0.4	97	0.01
		48	1.6	73	0.3	98	0.01
		49	2.5	74	0.3	99	0.01
		50	2.1	75	0.2	100	0.01
		51	1.8	76	0.2		
		52	1.7	77	0.1		
		53	1.9	78	0.1		
		54	2.1	79	0.09		
		55	2.3	80	0.08		
		56	2.5	81	0.08		
		57	2.6	82	0.05		
		58	2.4	83	0.06		
		59	2.1	84	0.07		
		60	2.3	85	0.07		
		61	1.8	86	0.06		
		62	1.9	87	0.05		
		63	1.6	88	0.05		
		64	1.4	89	0.05		
		65	1.1	90	0.04		
		66	0.7	91	0.03		
		67	0.6	92	0.02		
		68	0.5	93	0.01		
		69	0.5	94	0.01		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 41.48 \times 14.14}{197} = 90.2$$

Total 41.48

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 3 July 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 880 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 Degrees

TIME OF RELEASE: 0612 hours

DURATION: 17 Seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-9 blank		26	0.4				
		27	2.3				
		28	3.2				
		29	3.6				
		30	2.1				
		31	1.8				
		32	1.5				
		33	1.3				
9	Trace	34	0.8				
10	0.01	35	1.2				
11	0.02	36	1.4				
12	0.05	37	4.1				
13	0.07	38	2.7				
14	0.07	39	0.9				
15	0.08	40	0.1				
16	0.1	41	0.05				
17	0.1	42	0.03				
18	0.1	43	0.01				
19	0.1	44	Trace				
20	0.1	45 - 100 blank					
21	0.2						
22	0.2						
23	0.2						
24	0.2						
25	0.3						

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 29.39 \times 18.79}{197} = 84.9$$

Total 29.39

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 3 July 1962 ALTITUDE: 150 feet

FLIGHT #: 5 ; Crosswind SWATH WIDTH: 1760 feet

SAMPLE LINE: A AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0649 hours

DURATION: 19.5 seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	blank	26	0.9	51	0.7	76	0.01
2	"	27	0.7	52	0.5	77	0.01
3	"	28	0.6	53	0.5	78	0.01
4	"	29	0.8	54	0.5	79	0.01
5	"	30	0.7	55	0.5	80	0.01
6	"	31	0.6	56	0.4	81	0.01
7	"	32	0.5	57	0.5	82	0.01
8	"	33	0.4	58	0.4	83	0.01
9	"	34	0.3	59	0.3	84	Trace
10	"	35	0.3	60	0.2	85	0.01
11	-	36	0.4	61	0.2	86	Trace
12	0.3	37	0.4	62	0.1	87	0.01
13	1.2	38	0.3	63	0.1	88	0.01
14	2.1	39	0.3	64	0.1	89	0.01
15	2.3	40	0.4	65	0.1	90	0.02
16	2.0	41	0.3	66	0.07	91	0.01
17	1.0	42	0.3	67	0.06	92	0.01
18	2.0	43	0.4	68	0.04	93	0.01
19	2.2	44	0.5	69	0.04	94	0.01
20	2.3	45	0.6	70	0.04	95	0.01
21	2.4	46	0.6	71	0.04	96	0.01
22	2.8	47	0.6	72	0.03	97	Trace
23	2.2	48	0.6	73	0.02	98	0.01
24	1.1	49	0.7	74	0.02	99	0.01
25	0.9	50	0.7	75	0.01	100	0.01

Total 43.40

SPRAY NOZZLE SPACING AND DATA

Test No.: 40 Date Calibrated. 3 July 1962 Date Test Flown: 4 July

Material Used: Purple Calibrated Flow Rate. 194 GPM

Nozzle Information

Ident	Qty	Description	Location
o	56	3/16" C135 S.S. Check valve body with D-16 1/4" solid stream	1 thru 7, 13 thru 21, 27 thru 40
+	16	1/4" C135 S.S. " " " " " " "	1 thru 4, 37 thru 40
Total	72		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Engine throttle position: Wide open

System pressure at engine; spraying 32 psi

Length of test run: 30 seconds Gallons pumped: 97

Remarks: Test flown 4 July. S.S. D-16 1/4" orifice solid stream nozzle installed on all check valve bodies.

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 4 July 1962

ALTITUDE: 200 feet

FLIGHT #: 1 ; Crosswind

SWATH WIDTH: 1540 feet

SAMPLE LINE: B

AIRCRAFT COURSE: 315 degrees

TIME OF RELEASE: 0440 hours

DURATION: 21 seconds

FLOW RATE: 194 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.07	26	0.2	51	0.8	76	2.4
2	0.07	27	0.2	52	0.6	77	1.7
3	0.07	28	0.2	53	0.6	78	0.5
4	0.09	29	0.2	54	0.7	79	-
5	0.09	30	0.2	55	0.8	81-100 Blank	
6	0.08	31	0.3	56	0.8		
7	0.1	32	0.3	57	0.9		
8	0.1	33	0.3	58	1.0		
9	0.1	34	0.3	59	1.6		
10	0.1	35	0.5	60	1.5		
11	0.2	36	0.5	61	1.9		
12	0.2	37	0.4	62	2.1		
13	0.2	38	0.3	63	1.7		
14	0.2	39	0.3	64	2.0		
15	0.2	40	0.3	65	2.2		
16	0.2	41	0.2	66	2.4		
17	0.2	42	0.4	67	2.6		
18	0.3	43	0.4	68	2.8		
19	0.3	44	0.5	69	2.9		
20	0.3	45	0.5	70	2.8		
21	0.3	46	0.6	71	2.7		
22	0.3	47	0.8	72	2.0		
23	0.2	48	0.7	73	1.8		
24	0.2	49	0.7	74	1.6		
25	0.2	50	0.7	75	2.6		

Total 62.37

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 4 July 1962

ALTITUDE: 150 feet

FLIGHT #: 2 ; Inwind

SWATH WIDTH: 480 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0508 hours

DURATION: 18 seconds

FLOW RATE: 194 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1 - 50 Blank				51	Trace	Station 76-100 blank	
				52	0.03		
				53	0.1		
				54	0.3		
				55	0.5		
				56	1.3		
				57	4.4		
				58	3.2		
				59	1.7		
				60	1.9		
				61	0.8		
				62	0.7		
				63	0.9		
				64	2.5		
				65	3.2		
				66	4.2		
				67	1.2		
				68	0.4		
				69	0.2		
				70	0.1		
				71	0.04		
				72	0.01		
				73	Trace		
				74	"		
				75	"		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 27.68 \times 20}{194} = 86.5$$

Total 27.68

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 4 July 1962

ALTITUDE: 150 feet

FLIGHT #: 3 ; Inwind

SWATH WIDTH: 580 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0539 hours

DURATION: 19 seconds

FLOW RATE: 194 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-31 Blank		32	-	57	0.05		
		33	-	58	0.03		
		34	2.9	59	0.01		
		35	2.6	60	0.01		
		36	1.8	61	Trace		
		37	1.1	62	0.01		
		38	1.2	63	Trace		
		39	1.3	64-100	Trace		
		40	1.6				
		41	2.5				
		42	2.7				
		43	2.9				
		44	1.8				
		45	1.8				
		46	1.0				
		47	0.8				
		48	0.5				
		49	0.5				
		50	0.4				
		51	0.4				
		52	0.2				
		53	0.1				
		54	0.08				
		55	0.08				
		56	0.05				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 28.42 \times 20}{194} = 91.1$$

Total 28.42

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 4 July 1962

ALTITUDE: 200 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 1120 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0601 hours

DURATION: 16 seconds

FLOW RATE: 194 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-43 blank		44	Trace				
		45	"				
		46	"				
		47	0.5				
		48	2.1				
		49	2.4				
		50	1.5				
		51	1.3				
		52	.9				
		53	.7				
		54	1.3				
		55	2.1				
		56	3.2				
		57	2.6				
		58	1.1				
		59	1.3				
		60	0.5				
		61	0.5				
		62	0.4				
		63	0.2				
		64	0.07				
		65	0.04				
		66	0.01				
		67	Trace				
		68-100	Trace				

% Recovery = $\frac{.202 \times 150 \times 22.72 \times 20}{194} = 71$

Total 22.72

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 4 July 1962 ALTITUDE: 150 feet

FLIGHT #: 5 ; Inwind SWATH WIDTH: 1380 feet

SAMPLE LINE: A AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0624 hours

DURATION: 18 seconds

FLOW RATE: 194 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1 - 28 blank		29	-	54	0.05		
		30	-	55	0.03		
		31	0.1	56	0.03		
		32	0.7	57	0.01		
		33	1.0	58	0.01		
		34	2.6	59	Trace		
		35	2.7	Station 60-100 Trace			
		36	2.9				
		37	1.2				
		38	1.1				
		39	0.7				
		40	0.8				
		41	1.9				
		42	2.3				
		43	3.1				
		44	2.5				
		45	1.2				
		46	0.9				
		47	0.2				
		48	0.4				
		49	0.2				
		50	0.1				
		51	0.15				
		52	0.1				
		53	0.07				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 27.05 \times 20}{194} = 84.5$$

Total 27.05

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 4 July 1962

ALTITUDE: 200 feet

FLIGHT #: 6 ; Crosswind

SWATH WIDTH: 1920 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0646 hours

DURATION: 13 seconds

FLOW RATE: ______ GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.02	26	0.15	v 51	0.5	76	0.8
2	0.02	27	0.15	52	0.6	77	0.7
3	0.04	28	0.15	53	0.7	78	0.9
4	0.04	29	0.15	54	0.7	79	1.2
5	0.04	30	0.2	55	0.7	80	1.2
6	0.06	31	0.15	56	0.6	81	1.7
7	0.04	32	0.15	57	0.7	82	1.5
8	0.08	33	0.15	58	0.6	83	1.9
9	0.08	34	0.15	59	0.6	84	2.1
10	0.08	35	0.15	60	0.7	85	1.9
11	0.09	36	0.2	61	0.7	86	1.8
12	0.09	37	0.2	62	0.8	87	2.0
13	0.1	38	0.2	63	0.8	88	2.0
14	0.1	39	0.2	64	0.7	89	1.8
15	0.1	40	0.2	65	0.9	90	1.3
16	0.1	41	0.2	66	1.0	91	1.7
17	0.1	42	0.15	67	0.9	92	1.4
18	0.1	43	0.2	68	1.0	93	1.7
19	0.1	44	0.2	69	1.0	94	1.6
20	0.1	45	0.2	70	1.1	95	1.3
21	0.1	46	0.2	71	1.1	96	0.4
22	0.1	47	0.2	72	1.0	97	-
23	0.1	48	0.3	73	0.9	98	-
24	0.15	49	0.2	74	0.9	99	-
25	0.15	50	0.3	75	0.9	100	-

Total 57.60

SPRAY NOZZLE SPACING AND DATA

Test No.: 41 Date Calibrated: 4 July 1962 Date Test Flown: 5 July

Material Used: Purple Calibrated Flow Rate: 197 GPM

Nozzle Information

Ident	Qty	Description	Location
o	56	3/4" 6135 S.S. Check valve body with Veejet U50120	1 thru 4, 13 thru 26, 29 thru 40
+	16	3/4" 6135 SS " " " " " "	1 thru 4, 37 thru 40
Total	72		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Engine throttle position: Wide open

System pressure at engine; spraying 32 psi

Length of test run: 30 seconds Gallons pumped: 98.5

Remarks: Test flown 5 July. S.S. Veejet U50120 flat spray nozzles installed on all check valve bodies.

MASS DEPOSIT

MATERIAL: Purple

DATE: 5 July 1962

FLIGHT #: 1 ; inwind

SAMPLE LINE: D

TIME OF RELEASE: 0442 hours

DURATION: 17 seconds

FLOW RATE: 197 GPM

AIRSPEED: Constant at 150 mph (130 knots)

ALTITUDE: 150 feet

SWATH WIDTH: 1040 feet

AIRCRAFT COURSE: 45° degrees

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
				51	1.1	76	0.2
Station 1-46 blank				52	1.2	77	0.1
				53	0.75	78	0.1
				54	0.8	79	0.08
				55	1.3	80	0.06
				56	1.6	81	0.08
				57	2.3	82	0.06
				58	3.2	83	0.06
				59	2.1	84	0.04
				60	1.8	85	0.04
				61	2.1	86	0.04
				62	0.9	87	0.02
				63	0.8	88	0.01
				64	0.7	89	0.01
				65	0.7	90	0.01
				66	0.7	91	0.01
				67	0.6	92	0.01
				68	0.4	93	0.02
				69	0.2	94	0.01
				70	0.1	95	0.01
				71	0.1	96	Trace
		47	-	72	0.1	97	"
		48	0.1	73	0.2	98	"
		49	3.2	74	0.2	99	"
		50	3.6	75	0.2	100	"

$$\% \text{ Recovery} = \frac{.202 \times 32.02 \times 20 \times 150}{197} = 98.5$$

Total = 32.02

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 5 July 1962

ALTITUDE: 200 feet

FLIGHT #: 2 ; Inwind

SWATH WIDTH: 1220 feet

SAMPLE LINE: D

AIRCRAFT COURSE: 45 degrees

TIME OF RELEASE: 0505 hours

DURATION: 16 seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-38 blank		39	-	64	0.8	89	0.1
		40	0.3	65	0.8	90	0.1
		41	1.2	66	0.6	91	0.1
		42	1.8	67	0.5	92	0.1
		43	1.7	68	0.6	93	0.1
		44	2.1	69	0.6	94	0.1
		45	2.0	70	0.7	95	0.1
		46	1.7	71	0.7	96	0.1
		47	1.7	72	0.7	97	0.1
		48	2.1	73	0.6	98	0.1
		49	2.1	74	0.6	99	0.07
		50	2.4	75	0.5	100	0.07
		51	2.6	76	0.5		
		52	2.5	77	0.4		
		53	2.4	78	0.4		
		54	2.2	79	0.4		
		55	1.9	80	0.3		
		56	1.5	81	0.2		
		57	1.6	82	0.2		
		58	1.4	83	0.1		
		59	1.3	84	0.1		
		60	1.3	85	0.1		
		61	1.1	86	0.1		
		62	0.9	87	0.1		
		63	0.9	88	0.1		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 52.54 \times 10}{197} = 91.9$$

Total = 52.54

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 5 July 1962 ALTITUDE: 150 feet

FLIGHT #: 3 ; Inwind SWATH WIDTH: 860 feet

SAMPLE LINE: A AIRCRAFT COURSE: 82 degrees

TIME OF RELEASE: 0530 hours

DURATION: 10 seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.2	26	0.9				
2	0.2	27	1.1				
3	0.2	28	1.2				
4	0.3	29	1.7				
5	0.4	30	2.3				
6	0.4	31	2.1				
7	0.4	32	2.2				
8	0.3	33	1.7				
9	0.3	34	1.7				
10	0.4	35	1.6				
11	0.3	36	1.4				
12	0.3	37	1.2				
13	0.3	38	1.9				
14	0.4	39	2.2				
15	0.5	40	2.2				
16	0.5	41	2.5				
17	0.6	42	2.5				
18	0.6	43	0.6				
19	0.5	44	--				
20	0.7	Station 45-100 blank					
21	0.7						
22	0.7						
23	0.9						
24	0.9						
25	1.0						

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 43.00 \times 18.4}{197} = 121$$

Total 43.00

MASS DEPOSIT

MATERIAL: Purple

DATE: 5 July 1962

FLIGHT #: 4 ; Inwind

SAMPLE LINE: B

TIME OF RELEASE: 0559 hours

DURATION: 19 seconds

FLOW RATE: 197 GPM

AIRSPEED: Constant at 150 mph (130 knots)

ALTITUDE: 150 feet

SWATH WIDTH: 840 feet

AIRCRAFT COURSE: 135 degrees

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-57 blank.						76	1.1
						77	1.1
						78	0.8
						79	0.6
						80	0.5
						81	0.4
						82	0.4
				58	-	83	0.4
				59	1.5	84	0.3
				60	1.5	85	0.4
				61	4.4	86	0.3
				62	1.9	87	0.3
				63	1.8	88	0.3
				64	1.2	89	0.3
				65	1.5	90	0.1
				66	1.6	91	0.1
				67	1.7	92	0.2
				68	2.2	93	0.1
				69	2.4	94	0.1
				70	2.3	95	0.1
				71	1.9	96	0.1
				72	1.9	97	0.1
				73	1.8	98	0.1
				74	1.7	99	0.1
				75	1.2	100	0.1

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 40.8 \times 18.12}{197} = 114$$

Total 40.8

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 5 July 1962 ALTITUDE: 150 feet

FLIGHT #: 5 ; Inwind SWATH WIDTH: 940 feet

SAMPLE LINE: A AIRCRAFT COURSE: 90 degrees

TIME OF RELEASE: 0628 hours

DURATION: 17 seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-41 Blank		42	-	67	0.2	92	Trace
		43	0.4	68	0.1	93	"
		44	1.4	69	0.08	94	"
		45	1.5	70	0.08	95	"
		46	2.8	71	0.06	96	"
		47	2.8	72	0.04	97	"
		48	2.1	73	0.04	98	"
		49	1.9	74	0.02	99	"
		50	1.3	75	Trace	100	"
		51	0.8	76	"		
		52	1.0	77	"		
		53	1.6	78	"		
		54	2.6	79	"		
		55	3.6	80	"		
		56	2.4	81	"		
		57	1.3	82	"		
		58	0.8	83	"		
		59	0.6	84	"		
		60	0.6	85	"		
		61	0.4	86	"		
		62	0.4	87	"		
		63	0.4	88	"		
		64	0.4	89	"		
		65	0.5	90	"		
		66	0.3	91	"		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 32.52 \times 20}{197} = 100$$

Total 32.52

MASS DEPOSIT

MATERIAL: Purple AIRSPEED: Constant 150 mph (130 knots)

DATE: 5 July 1962 ALTITUDE: 150 feet

FLIGHT #: 6 ; Crosswind SWATH WIDTH: 1340 feet

SAMPLE LINE: C AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0648 hours

DURATION: 12 seconds

FLOW RATE: 197 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	1.4	26	0.6	51	Trace		
2	2.1	27	0.5	52	"		
3	2.2	28	0.5	53	"		
4	2.5	29	0.4	54	"		
5	2.2	30	0.4	55	"		
6	1.7	31	0.1	56	"		
7	1.8	32	0.2	57	"		
8	2.0	33	0.2	58	"		
9	2.3	34	0.2	59	"		
10	2.5	35	0.2	60	"		
11	2.6	36	0.2	61	"		
12	2.5	37	0.2	62	"		
13	2.4	38	0.2	63	"		
14	2.2	39	0.9	64	"		
15	2.2	40	0.1	65	"		
16	2.0	41	0.1	66	"		
17	1.8	42	0.1	67	"		
18	1.3	43	0.1	68	"		
19	1.2	44	0.1	69	--		
20	0.7	45	0.1	Stations 70-100 blank			
21	0.5	46	0.1				
22	0.3	47	0.08				
23	0.5	48	0.04				
24	0.7	49	0.01				
25	0.6	50	0.01				

Total 47.04

SPRAY NOZZLE SPACING AND DATA

Test No.: 42 Date Calibrated: 9 July 1962 Date Test Flown: 6 July

Material Used: Purple Calibrated Flow Rate: 179 GPM

Nozzle Information

Ident	Qty	Description	Location
o	56	[illegible] check valve body, only	1 thru 7, 13 thru 21, 29 thru 40
+			
[illegible]	56		

Nozzle location, same on each boom. No. 1 is most inboard position.

1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54

Engine throttle position: 31/ [illegible]

System pressure at engine; spraying 33 psi

Length of test run: 30 seconds Gallons pumped: 89.5

Remarks: Test flown 6 July. Calibration checked on 9 July.

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 6 July 1962

ALTITUDE: 150 feet

FLIGHT #: 1 ; Inwind

SWATH WIDTH: 760 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 090 degrees

TIME OF RELEASE: 0441 hours

DURATION: 24 seconds

FLOW RATE: 179 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
				59	-	84	0.25
Stations 1-58 blank				60	2.7	85	0.25
				61	1.4	86	0.2
				62	1.9	87	0.2
				63	1.2	88	0.2
				64	0.9	89	0.1
				65	0.8	90	0.1
				66	1.0	91	0.1
				67	1.2	92	0.08
				68	1.5	93	0.08
				69	1.9	94	0.06
				70	2.6	95	0.06
				71	2.3	96	0.04
				72	1.1	97	0.04
				73	0.9	98	0.01
				74	0.8	99	Trace
				75	0.7	100	-
				76	0.5		
				77	0.4		
				78	0.45		
				79	0.35		
				80	0.4		
				81	0.45		
				82	0.45		
				83	0.25		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 27.92 \times 15.32}{179} = 72.4$$

Total 27.92

MASS DEPOSIT

MATERIAL: Purple

DATE: 6 July 1962

FLIGHT #: 2 ; Inwind

SAMPLE LINE: B

TIME OF RELEASE: 0503 hours

DURATION: 19 seconds

FLOW RATE: 179 GPM

AIRSPEED: Constant at 150 mph (130 knots)

ALTITUDE: 200 feet

SWATH WIDTH: 1060 feet

AIRCRAFT COURSE: 135 degrees

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1 - 45 blank		46	-	71	0.4	96	Trace
		47	Trace	72	0.4	97	"
		48	0.3	73	0.3	98	"
		49	2.4	74	0.3	99	"
		50	1.3	75	0.3	100	"
		51	1.8	76	0.2		
		52	1.3	77	0.2		
		53	0.9	78	0.2		
		54	0.9	79	0.2		
		55	1.2	80	0.2		
		56	1.5	81	0.2		
		57	1.9	82	0.2		
		58	2.4	83	0.2		
		59	2.3	84	0.2		
		60	1.9	85	0.2		
		61	1.6	86	0.2		
		62	1.2	87	0.1		
		63	0.8	88	0.1		
		64	0.7	89	0.1		
		65	0.7	90	0.08		
		66	0.7	91	0.07		
		67	0.65	92	0.05		
		68	0.5	93	0.04		
		69	0.5	94	0.02		
		70	0.4	95	Trace		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 32.31 \times 20}{179} = 109.4\%$$

Total 32.31

MASS DEPOSIT

MATERIAL: Purple

DATE: 6 July 1962

FLIGHT #: 3 ; Inwind

SAMPLE LINE: B

TIME OF RELEASE: 0522 hours

DURATION: 15 seconds

FLOW RATE: 179 GPM

AIRSPEED: Constant 150 mph (130 knots)

ALTITUDE: 150 feet

SWATH WIDTH: 740 feet

AIRCRAFT COURSE: 135 degrees

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
		29	-	55	0.1		
Stations 1-28 blank		30	Trace	56	0.1		
		31	"	57	0.1		
		32	"	58	0.04		
		33	"	59	0.04		
		34	"	60	0.04		
		35	3.8	61	0.02		
		36	3.4	62	0.01		
		37	2.6	63	Trace		
		38	1.1	64	"		
		39	0.8	65	"		
		40	1.1	66	"		
		41	1.45	67	"		
		42	1.5	68	-		
		43	1.8	Stations 69-100 Blank			
		44	3.1				
		45	2.3				
		46	2.0				
		47	0.9				
		48	0.8				
		49	0.8				
		50	0.6				
		51	0.35				
		52	0.35				
		53	0.3				
		54	0.2				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 29.70 \times 20}{179} = 100.5\%$$

Total 29.70

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 Knots)

DATE: 6 July 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 1300 feet

SAMPLE LINE: B

AIRCRAFT COURSE: 135 degrees

TIME OF RELEASE: 0540 hours

DURATION: 17 seconds

FLOW RATE: 179 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-33 blank		34	-	59	0.35	84	0.01
		35	0.5	60	0.3	85	0.01
		36	3.6	61	0.3	86	0.01
		37	2.6	62	0.2	87	0.01
		38	2.4	63	0.15	88	0.01
		39	1.2	64	0.01	89	0.01
		40	0.9	65	0.08	90	0.01
		41	1.3	66	0.08	91	0.01
		42	1.5	67	0.05	92	Trace
		43	2.4	68	0.05	93	"
		44	2.4	69	0.04	94	"
		45	2.3	70	0.04	95	"
		46	1.8	71	0.04	96	"
		47	0.9	72	0.03	97	"
		48	0.9	73	0.03	98	"
		49	0.8	74	0.03	99	"
		50	0.8	75	0.02	100	"
		51	0.7	76	0.02		
		52	0.6	77	0.02		
		53	0.5	78	0.01		
		54	0.5	79	0.01		
		55	0.5	80	0.01		
		56	0.5	81	0.01		
		57	0.4	82	0.01		
		58	0.35	83	0.01		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 32.42 \times 20}{179} = 109.8$$

Total 32.42

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 6 July 1962

ALTITUDE: 150 feet

FLIGHT #: 5 ; Inwind

SWATH WIDTH: 1200 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 090 degrees

TIME OF RELEASE: 0606 hours

DURATION: 12 seconds

FLOW RATE: 179 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-39 Blank		40	-	65	2.3	90	0.08
		41	Trace	66	1.8	91	0.08
		42	"	67	0.9	92	0.05
		43	"	68	0.8	93	0.05
		44	"	69	0.8	94	0.04
		45	"	70	0.8	95	0.04
		46	"	71	0.7	96	0.04
		47	"	72	0.6	97	0.02
		48	"	73	0.5	98	0.02
		49	"	74	0.5	99	0.02
		50	"	75	0.5	100	0.02
		51	"	76	0.5		
		52	"	77	0.4		
		53	"	78	0.4		
		54	"	79	0.5		
		55	"	80	0.4		
		56	3.2	81	0.3		
		57	2.8	82	0.2		
		58	1.9	83	0.2		
		59	0.9	84	0.2		
		60	0.8	85	0.15		
		61	0.8	86	0.1		
		62	1.5	87	0.1		
		63	1.5	88	0.1		
		64	2.0	89	0.08		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 29.69 \times 20}{179} = 100.5$$

Total 29.69

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 6 July 1962

ALTITUDE: 150 feet

FLIGHT #: 6 ; Crosswind

SWATH WIDTH: 1500 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0625 hours

DURATION: 14 seconds

FLOW RATE: 179 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	1.5	51	0.4	76	0.02
2	"	27	2.4	52	0.3	77	0.02
3	"	28	2.0	53	0.3	78	0.01
4	"	29	1.8	54	0.2	79	0.01
5	"	30	1.0	55	0.2	80	0.02
6	"	31	1.5	56	0.2	81	0.02
7	"	32	1.6	57	0.2	82	0.02
8	"	33	1.6	58	0.2	83	0.02
9	"	34	1.8	59	0.15	84	0.02
10	"	35	1.8	60	0.1	85	0.02
11	"	36	1.9	61	0.1	86	0.02
12	"	37	1.6	62	0.08	87	0.01
13	"	38	1.3	63	0.06	88	0.02
14	"	39	0.9	64	0.04	89	0.02
15	"	40	0.8	65	0.04	90	0.01
16	"	41	0.5	66	0.04	91	0.01
17	"	42	0.5	67	0.02	92	0.01
18	"	43	0.5	68	0.02	93	0.01
19	"	44	0.6	69	0.02	94	0.01
20	"	45	0.6	70	0.02	95	0.01
21	"	46	0.5	71	0.02	96	0.01
22	"	47	0.5	72	0.02	97	0.01
23	"	48	0.5	73	0.02	98	0.01
24	Trace	49	0.4	74	0.02	99	0.01
25	0.1	50	0.4	75	0.02	100	0.01

Total 31.75

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 6 July 1962

ALTITUDE: 200 feet

FLIGHT #: 7 ; Crosswind

SWATH WIDTH: 1540 feet

SAMPLE LINE: D

AIRCRAFT COURSE: 225 degrees

TIME OF RELEASE: 0646 hours

DURATION: 16 seconds

FLOW RATE: 179 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-21 Blank		22	-	47	0.5	72	0.01
		23	1.5	48	0.5	73	0.01
		24	1.6	49	0.45	74	0.01
		25	1.6	50	0.45	75	Trace
		26	2.4	51	0.3	Stations 76-100 Trace	
		27	1.6	52	0.3		
		28	1.5	53	0.3		
		29	1.5	54	0.25		
		30	1.7	55	0.2		
		31	1.7	56	0.2		
		32	1.7	57	0.1		
		33	1.6	58	0.1		
		34	1.8	59	0.1		
		35	1.8	60	0.08		
		36	1.4	61	0.08		
		37	1.2	62	0.08		
		38	1.1	63	0.06		
		39	0.9	64	0.04		
		40	0.8	65	0.04		
		41	0.7	66	0.04		
		42	0.7	67	0.02		
		43	0.6	68	0.02		
		44	0.5	69	0.02		
		45	0.5	70	0.01		
		46	0.5	71	0.01		

Total 35.28

MASS DEPOSIT

MATERIAL: Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 6 July 1962

ALTITUDE: 250 feet

FLIGHT #: 8 ; Crosswind

SWATH WIDTH: 1900 feet

SAMPLE LINE: D

AIRCRAFT COURSE: 225 degrees

TIME OF RELEASE: 0703 hours

DURATION: 17 seconds

FLOW RATE: 179 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	-	26	0.35	51	0.1		
2	-	27	0.35	52	0.01		
3	-	28	0.40	53	0.02		
4	Trace	29	0.40	54	0.01		
5	Trace	30	0.30	55	Trace		
6	0.2	31	0.3	56	0.01		
7	1.5	32	0.2	57	0.01		
8	1.9	33	0.15	58	0.01		
9	1.8	34	0.15	59	0.01		
10	1.8	35	0.1	60	0.01		
11	1.1	36	0.1	61	Trace		
12	1.0	37	0.1	Stations 62-100	Trace		
13	1.35	38	0.1				
14	1.5	39	0.1				
15	1.5	40	0.1				
16	1.9	41	0.1				
17	2.1	42	0.2				
18	2.1	43	0.2				
19	1.9	44	0.2				
20	1.1	45	0.2				
21	1.0	46	0.2				
22	0.9	47	0.2				
23	0.8	48	0.2				
24	0.65	49	0.2				
25	0.5	50	0.1				

Total 31.80

Date Calibrated: [illegible] Date Test Flown: 10 July

Calibrated Flow Rate: 153 GPM

Source Information

Location

1 3 5 7 9 11 13 15 17 ... 27 29 31 33 35 37 39 41 43 45 47 49 51 53
... 38 40 ... 46 48 50 52 54

Length of test ... seconds. Gallons pumped: 76.5

Test flown 10 July. New Teflon & rubber diaphragms installed in check valve bodies.

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

DATE: 10 July 1962

FLIGHT #: 1 ; Inwind

SAMPLE LINE: C

TIME OF RELEASE: 0440 hours

DURATION: 16.25 seconds

FLOW RATE: 153 GPM

AIRSPEED: Constant at 150 mph (130 knots)

ALTITUDE: 150 feet

SWATH WIDTH: 820 feet

AIRCRAFT COURSE: 360 degrees

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-25 Blank		26	Trace	51	0.8		
		27	"	52	0.9		
		28	"	53	0.9		
		29	"	54	0.9		
		30	"	55	1.0		
		31	0.01	56	1.0		
		32	0.01	57	1.2		
		33	0.01	58	1.1		
		34	0.01	59	0.8		
		35	0.01	60	0.9		
		36	0.02	61	0.8		
		37	0.02	62	0.9		
		38	0.04	63	0.9		
		39	0.08	64	1.1		
		40	0.08	65	1.3		
		41	0.08	66	1.3		
		42	0.10	67	0.9		
		43	0.20	68	-		
		44	0.30	Stations 69-100 Blank			
		45	0.40				
		46	0.4				
		47	0.5				
		48	0.5				
		49	0.6				
		50	0.7				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 20.77 \times 20}{153} = 82.3\%$$

Total 20.77

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 10 July 1962

ALTITUDE: 150 feet

FLIGHT #: 2 ; Inwind

SWATH WIDTH: 1360 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0504 hours

DURATION: 12 seconds

FLOW RATE: 153 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Stations 1-30 blank		31	-	56	1.3		
		32	Trace	57	1.0		
		33	"	58	0.2		
		34	"	59	0.1		
		35	0.02	60	0.1		
		36	0.04	61	0.08		
		37	0.06	62	0.08		
		38	0.06	63	0.04		
		39	0.08	64	0.02		
		40	0.1	65	Trace		
		41	0.2	Stations 66-100 Trace			
		42	0.3				
		43	0.4				
		44	0.7				
		45	1.3				
		46	1.3				
		47	0.8				
		48	0.5				
		49	0.5				
		50	0.6				
		51	0.8				
		52	0.9				
		53	1.0				
		54	1.1				
		55	1.3				

% Recovery = .202 x 150 x 14.98 x 19.13 = 56.8

Total 14.98

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple AIRSPEED: Constant at 150 mph (130 knots)

DATE: 10 July 1962 ALTITUDE: 150 feet

FLIGHT #: 3 ; Inwind SWATH WIDTH: 1340 feet

SAMPLE LINE: C AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0525 hours

DURATION: 14 seconds

FLOW RATE: 153 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-25 Blank		26	Blank	51	0.8	76	0.04
		27	"	52	0.5	77	0.02
		28	"	53	0.4	78	0.02
		29	"	54	0.3	79	0.02
		30	"	55	0.2	80	0.01
		31	"	56	0.1	81	0.01
		32	"	57	0.1	82	0.01
		33	Trace	58	0.1	83	0.01
		34	"	59	0.1	84	Trace
		35	0.1	60	0.08	Stations 85-100	
		36	1.2	61	0.1		Trace
		37	2.2	62	0.1		
		38	1.0	63	0.08		
		39	0.9	64	0.1		
		40	0.9	65	0.1		
		41	0.8	66	0.08		
		42	0.9	67	0.08		
		43	0.9	68	0.08		
		44	1.2	69	0.07		
		45	1.3	70	0.07		
		46	1.4	71	0.06		
		47	1.3	72	0.04		
		48	0.9	73	0.06		
		49	1.0	74	0.04		
		50	0.8	75	0.04		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 20.72 \times 12.86}{153} = 52.0$$

Total 20.72

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 10 July 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 1160 feet

SAMPLE LINE: D

AIRCRAFT COURSE: 045 degrees

TIME OF RELEASE: 0544 hours

DURATION: 16 seconds

FLOW RATE: 153 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	Trace	51	0.6		
2	"	27	"	52	0.7		
3	Blank	28	"	53	0.8		
4	Trace	29	"	54	1.7		
5	"	30	"	55	1.5		
6	"	31	"	56	0.5		
7	"	32	" "	57	0.2		
8	"	33	" "	58	0.2		
9	"	34	"	59	0.08		
10	"	35	0.01	60	0.02		
11	"	36	0.01	61	Trace		
12	"	37	0.01	62	Trace		
13	"	38	0.02	63	Blank		
14	"	39	0.04	Station 64-100 blank			
15	"	40	0.08				
16	"	41	0.1				
17	"	42	0.3				
18	"	43	0.5				
19	"	44	0.9				
20	"	45	1.2				
21	"	46	1.3				
22	"	47	1.0				
23	"	48	0.9				
24	"	49	0.9				
25	"	50	0.7				

% Recovery = .202 x 150 x 14.27 x 19.23 = 54.3

Total 14.27

MASS DEPOSIT

MATERIAL: 2 Fuel Oil, 1 Purple

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 10 July 1962

ALTITUDE: 150 feet

FLIGHT #: 5 ; Crosswind

SWATH WIDTH: 2000 feet

SAMPLE LINE: B

AIRCRAFT COURSE: 315 degrees

TIME OF RELEASE: 0605 hours

DURATION: 15 seconds

FLOW RATE: 153 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.04	26	0.7	51	0.1	76	0.06
2	0.04	27	0.6	52	0.2	77	0.06
3	0.3	28	0.55	53	0.1	78	0.04
4	0.35	29	0.5	54	0.1	79	0.04
5	0.6	30	0.5	55	0.1	80	0.04
6	0.5	31	0.45	56	0.1	81	0.04
7	0.6	32	0.4	57	0.1	82	0.02
8	0.8	33	0.3	58	0.1	83	0.02
9	0.85	34	0.2	59	0.1	84	0.01
10	1.0	35	0.1	60	0.1	85	0.01
11	1.0	36	0.1	61	0.1	86	0.01
12	1.0	37	0.1	62	0.08	87	0.01
13	0.9	38	0.08	63	0.06	88	0.01
14	0.9	39	0.1	64	0.04	89	0.01
15	0.8	40	0.2	65	0.04	90	0.01
16	0.8	41	0.2	66	0.02	91	0.01
17	0.9	42	0.1	67	0.02	92	0.01
18	0.85	43	0.1	68	0.02	93	0.01
19	0.8	44	0.2	69	0.02	94	0.01
20	0.8	45	0.3	70	0.02	95	0.01
21	0.75	46	0.2	71	0.02	96	0.02
22	0.8	47	0.2	72	0.04	97	0.02
23	0.9	48	0.3	73	0.04	98	0.02
24	0.85	49	0.1	74	0.04	99	0.02
25	0.6	50	0.2	75	0.08	100	0.02

Total 26.79

SPRAY NOZZLE DATA

Test No.: 45 Date Calibrated. 10 July [illegible] Date Test Flown: 11 July

Material Used: Fuel oil, only Calibrated Flow Rate. ______

Nozzle Information

Ident	Qty	Description	Location
o	52	3/8" 0135 S.S. Check valve body, only	[illegible]
+			
Total	52		

Nozzle location, same on each boom. No. 1 is most inboard position.

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50

Engine throttle position: 1/2 open

System pressure at engine; spraying 20 psi

Length of test run: 30 seconds Gallons pumped. 75

Remarks: Test flown 11 July.

MASS DEPOSIT

MATERIAL: Fuel Oil

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 11 July 1962

ALTITUDE: 150 feet

FLIGHT #: 1 ; Crosswind

SWATH WIDTH: 1820 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 270 degrees

TIME OF RELEASE: 0451 hours

DURATION: 16 seconds

FLOW RATE: 150 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	1.1	51	0.7	76	0.3
2	"	27	1.2	52	0.6	77	0.3
3	"	28	1.2	53	0.5	78	0.2
4	"	29	1.1	54	0.5	79	0.2
5	"	30	0.9	55	0.5	80	0.2
6	"	31	1.2	56	0.5	81	0.2
7	"	32	1.2	57	0.4	82	0.2
8	"	33	1.1	58	0.45	83	0.2
9	0.1	34	1.1	59	0.4	84	0.2
10	0.1	35	1.1	60	0.5	85	0.1
11	0.3	36	1.0	61	0.4	86	0.1
12	0.5	37	0.9	62	0.4	87	0.2
13	0.5	38	1.0	63	0.4	88	0.2
14	0.5	39	0.9	64	0.4	89	0.1
15	0.5	40	0.8	65	0.3	90	0.1
16	0.5	41	0.7	66	0.3	91	0.1
17	0.6	42	0.9	67	0.3	92	0.1
18	0.5	43	0.8	68	0.2	93	0.1
19	0.8	44	0.9	69	0.2	94	0.1
20	0.8	45	0.8	70	0.2	95	0.1
21	0.9	46	0.8	71	0.2	96	0.1
22	0.9	47	0.9	72	0.2	97	0.1
23	1.0	48	0.7	73	0.2	98	0.1
24	1.1	49	0.8	74	0.2	99	0.1
25	1.1	50	0.7	75	0.2	100	0.1

Total 47.55

MASS DEPOSIT

MATERIAL:	Fuel Oil	AIRSPEED:	Constant at 150 mph (130 knots)
DATE:	11 July 1962	ALTITUDE:	150 feet
FLIGHT #:	2 ; Inwind	SWATH WIDTH:	960 feet
SAMPLE LINE:	D	AIRCRAFT COURSE:	045 degrees
TIME OF RELEASE:	0512 hours		
DURATION:	17 seconds		
FLOW RATE:	150 GPM		

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	0.1	26	0.9	Stations 51-100 Blank			
2	0.1	27	0.9				
3	0.2	28	1.0				
4	0.2	29	1.0				
5	0.2	30	1.1				
6	0.2	31	1.2				
7	0.2	32	1.2				
8	0.3	33	1.1				
9	0.3	34	1.2				
10	0.4	35	1.1				
11	0.3	36	0.9				
12	0.4	37	1.0				
13	0.5	38	1.1				
14	0.5	39	1.2				
15	0.5	40	1.3				
16	0.6	41	1.2				
17	0.6	42	1.0				
18	0.7	43	1.0				
19	0.7	44	1.1				
20	0.7	45	1.0				
21	0.7	46	0.9				
22	0.8	47	1.1				
23	0.7	48	1.0				
24	0.9	49	0.5				
25	0.9	50	-				

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 36.70 \times 13.89}{150} = 103.0$$

Total 36.70

MASS DEPOSIT

MATERIAL: Fuel Oil

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 11 July 1962

ALTITUDE: 150 feet

FLIGHT #: 3 ; Inwind

SWATH WIDTH: 2000 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 90 degrees

TIME OF RELEASE: 0534 hours

DURATION: 16.5 seconds

FLOW RATE: 150 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Trace	26	Trace	51	Trace	76	0.8
2	"	27	"	52	"	77	0.8
3	"	28	"	53	0.1	78	0.8
4	"	29	"	54	0.1	79	0.8
5	"	30	"	55	0.3	80	0.7
6	"	31	"	56	0.4	81	0.7
7	"	32	"	57	0.6	82	0.7
8	"	33	"	58	0.7	83	0.8
9	"	34	"	59	0.8	84	0.8
10	"	35	"	60	0.8	85	0.8
11	"	36	"	61	0.8	86	0.7
12	"	37	"	62	0.8	87	0.6
13	"	38	"	63	0.9	88	0.7
14	"	39	"	64	0.9	89	0.6
15	"	40	"	65	0.9	90	0.6
16	"	41	"	66	1.0	91	0.6
17	"	42	"	67	1.0	92	0.5
18	"	43	"	68	1.1	93	0.5
19	"	44	"	69	1.1	94	0.4
20	"	45	"	70	1.0	95	0.5
21	"	46	"	71	1.0	96	0.4
22	"	47	"	72	0.9	97	0.4
23	"	48	"	73	0.9	98	0.3
24	"	49	"	74	0.9	99	0.4
25	"	50	"	75	0.9	100	0.3

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 33.10 \times 20}{150} = 133.7$$

Total 33.10

MASS DEPOSIT

MATERIAL: Fuel Oil

AIRSPEED: Constant at 150 mph (130 knots)

DATE: 11 July 1962

ALTITUDE: 150 feet

FLIGHT #: 4 ; Inwind

SWATH WIDTH: 1040 feet

SAMPLE LINE: A

AIRCRAFT COURSE: 90 degrees

TIME OF RELEASE: 0552 hours

DURATION: 18 seconds

FLOW RATE: 150 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
Station 1-46 Blank		47	-	73	0.6	99	0.2
		48	0.2	74	0.6	100	0.2
		49	0.3	75	0.6		
		50	0.7	76	0.6		
		51	0.8	77	0.6		
		52	0.9	78	0.6		
		53	0.9	79	0.5		
		54	0.8	80	0.6		
		55	0.8	81	0.5		
		56	0.8	82	0.6		
		57	1.0	83	0.5		
		58	1.0	84	0.5		
		59	1.0	85	0.5		
		60	1.0	86	0.5		
		61	0.9	87	0.5		
		62	1.0	88	0.4		
		63	1.0	89	0.4		
		64	0.9	90	0.5		
		65	0.9	91	0.4		
		66	0.8	92	0.3		
		67	0.7	93	0.3		
		68	0.7	94	0.3		
		69	0.8	95	0.3		
		70	0.8	96	0.3		
		71	0.7	97	0.3		
		72	0.7	98	0.2		

$$\% \text{ Recovery} = \frac{.202 \times 150 \times 32.50 \times 20}{150} = 131.3$$

Total 32.50

MASS DEPOSIT

MATERIAL: Fuel Oil

AIRSPEED: Constant 150 mph (130 knots)

DATE: 11 July 1962

ALTITUDE: 200 feet

FLIGHT #: 5 ; Crosswind

SWATH WIDTH: 1940 feet

SAMPLE LINE: C

AIRCRAFT COURSE: 360 degrees

TIME OF RELEASE: 0611 hours

DURATION: 13 seconds

FLOW RATE: 150 GPM

STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.	STATION	G.P.A.
1	Blank	26	0.7	51	0.01		
2	-	27	0.6	52	Trace		
3	0.3	28	0.7	Stations	53-100 Trace		
4	0.3	29	0.6				
5	0.8	30	0.5				
6	0.9	31	0.5				
7	0.9	32	0.5				
8	0.8	33	0.5				
9	0.8	34	0.4				
10	0.8	35	0.4				
11	0.7	36	0.3				
12	0.8	37	0.3				
13	0.9	38	0.4				
14	0.9	39	0.3				
15	1.0	40	0.3				
16	0.9	41	0.2				
17	0.8	42	0.3				
18	0.8	43	0.3				
19	0.8	44	0.2				
20	0.8	45	0.1				
21	0.8	46	0.1				
22	0.8	47	0.06				
23	0.7	48	0.02				
24	0.6	49	0.01				
25	0.7	50	Trace				

Total 25.90

MASS MEDIAN DIAMETER

DATE: 24 June 1962

FLIGHT #: 1 ; Crosswind

SAMPLE LINE: D

FLOW RATE: 180 GPM

SPREAD FACTOR: 6.0

CONVERSION FACTOR: 2.5

PAPER: Kromekote (Red)

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
	1	4500			
	2	4200			
	3	4100			
	4	3700*			
	5	3500			
	6	3400			
	7	3200			
	8	3100			

$$\text{MMD} = \frac{3700^*}{15} = 247 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{4500}{6} = 750$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25$$

MASS MEDIAN DIAMETER

DATE: 24 June 1962

FLIGHT #: 2 ; Inwind

SAMPLE LINE: D

FLOW RATE: 180 GPM

SPREAD FACTOR: 6.0

CONVERSION FACTOR: 2.5

PAPER: Kromekote (Red)

SPRAY MATERIAL: Purple

$$MMD = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
59	1	4400*			
60	2	4300			
60	3	4100			
60	4	4000			
60	5	4000			
59	6	3800			
59	7	3750			
59	8	3600			
59	9	3500			
59	10	3300			

$$MMD = \frac{4400}{15} = 293 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{4400}{6} = 733 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 24 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 3 ; Crosswind

CONVERSION FACTOR: 2.5

SAMPLE LINE: D

PAPER: Kromekote (Red)

FLOW RATE: 180 GPM

SPRAY MATERIAL: Purple

$$MMD = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta	Drop #	Size
87	1	5500			
87	2	5300			
86	3	4100			
86	4	3800*			
85	5	3600			
85	6	3500			
85	7	3400			
85	8	3300			
85	9	3150			

$$MMD = \frac{3800}{15} = 253 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{5500}{6} = 916 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 24 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 4 ; Crosswind

CONVERSION FACTOR: 2.5

SAMPLE LINE: C

PAPER: Kromekote (Red)

FLOW RATE: 180 GPM

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor} \times \text{Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
98	1	4400			
97	2	4050			
96	3	3750*			
95	4	3600			
94	5	3450			
94	6	3300			
94	7	3200			
94	8	3000			

$$\text{MMD} = \frac{3750}{15} = 250 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{4400}{6} = 733 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 26 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 1 ; Crosswind

CONVERSION FACTOR: 2.5

SAMPLE LINE: D

PAPER: Kromekote (Red)

FLOW RATE: 180 GPM

SPRAY MATERIAL: 1 Purple, 2 Fuel Oil

$$MMD = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
64	1	4100			
66	2	3600			
67	3	3500			
66	4	3100*			
66	5	3000			
66	6	2800			
66	7	2700			
66	8	2600			

$$MMD = \frac{3100}{15} = 207 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{4100}{6} = 683 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 26 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 2 ; Inwind

CONVERSION FACTOR: 2.5

SAMPLE LINE: B

PAPER: Kromekote (Red)

FLOW RATE: 180 GPM

SPRAY MATERIAL: 2 Fuel Oil, 1 Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
62	1	4500			
60	2	4200			
61	3	4000			
53	4	3750			
61	5	3500*			
58	6	3400			
54	7	3250			
54	8	3150			
54	9	3150			

$$\text{MMD} = \frac{3500}{15} = 233 \text{ microns}$$

Max. Sph. Dia. ≅ 750 microns

Min. Sph. Dia. ≅ 42 microns

MASS MEDIAN DIAMETER

DATE: 26 June 1962 SPREAD FACTOR: 6.0

FLIGHT #: 3 ; Inwind CONVERSION FACTOR: 2.5

SAMPLE LINE: B PAPER: Kromekote (Red)

FLOW RATE: 180 GPM SPRAY MATERIAL: 2 Fuel Oil, 1 Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
52	1	3750			
52	2	3400*			
52	3	3200			
52	4	3100			
52	5	2900			
53	6	2700			
53	7	2600			

$$\text{MMD} = \frac{3400}{15} = 226 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{3750}{6} = 625 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 26 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 4 ; Inwind

CONVERSION FACTOR: 2.5

SAMPLE LINE: C

PAPER: Kromekote (Red)

FLOW RATE: 180 GPM

SPRAY MATERIAL: 2 Fuel Oil, 1 Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
42	1	5100			
36	2	4850			
42	3	4300			
36	4	3500*			
35	5	3300			
35	6	3200			
35	7	3100			
35	8	3000			

$$\text{MMD} = \frac{3500}{15} = 233 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{5100}{6} = 850 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 26 June 1962

FLIGHT #: 5 ; Crosswind

SAMPLE LINE: A

FLOW RATE: 180 GPM

SPREAD FACTOR: 6.0

CONVERSION FACTOR: 2.5

PAPER: Kromekote (Red)

SPRAY MATERIAL: 2 Fuel Oil, 1 Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
11	1	4100			
11	2	3700			
12	3	3200*			
12	4	3100			
12	5	3000			
13	6	2900			
12	7	2700			
13	8	2600			

$$\text{MMD} = \frac{3200}{15} = 213 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{4100}{6} = 683 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 26 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 6 ; Inwind

CONVERSION FACTOR: 2.5

SAMPLE LINE: C

PAPER: Kromekote (Red)

FLOW RATE: 180 GPM

SPRAY MATERIAL: 2 Fuel Oil, 1 Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor X Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
63	1	3700*			
65	2	3600			
64	3	3450			
63	4	3400			
64	5	3300			
64	6	3250			
64	7	3200			
64	8	3150			
64	9	3100			

$$\text{MMD} = \frac{3700}{15} = 246 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{3700}{6} = 617 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 27 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 1 ; Inwind

CONVERSION FACTOR: 2.5

SAMPLE LINE: B

PAPER: Kromekote (Red)

FLOW RATE: 206 GPM

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
49	1	6900			
49	2	6000			
49	3	5500			
49	4	5000			
49	5	4500*			
49	6	4400			
49	7	4300			
49	8	4100			
49	9	3900			
49	10	3800			

$$\text{MMD} = \frac{4500}{15} = 300 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{6900}{6} = 1150 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 27 June 1962

FLIGHT #: 2 ; Inwind

SAMPLE LINE: B

FLOW RATE: 206 GPM

SPREAD FACTOR: 6.0

CONVERSION FACTOR: 2.5

PAPER: Kromekote (Red)

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
33	1	6600			
26	2	6100			
26	3	5600			
33	4	5200			
36	5	4400*			
33	6	4300			
33	7	4200			
26	8	4100			
26	9	4000			

$$\text{MMD} = \frac{4400}{15} = 293 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{6600}{6} = 1100 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 27 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 3 ; Inwind

CONVERSION FACTOR: 2.5

SAMPLE LINE: C

PAPER: Kromekote (Red)

FLOW RATE: 206 GPM

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
67	1	7500	66	15	4150
66	2	6900	66	16	4000
67	3	6250			
72	4	5750			
67	5	5700			
67	6	5600			
66	7	5200			
66	8	5150			
66	9	5100			
66	10	4600*			
67	11	4450			
66	12	4400			
66	13	4325			
66	14	4200			

$$\text{MMD} = \frac{4600}{15} = 306 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{7500}{6} = 1250 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 27 Jun 1962

SPREAD FACTOR: 6.0

FLIGHT #: 4 ; Inwind

CONVERSION FACTOR: 2.5

SAMPLE LINE: C

PAPER: Kromekote (Red)

FLOW RATE: 206 GPM

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
72	1	8000			
72	2	7200			
72	3	6800			
72	4	6500			
72	5	5300			
72	6	5100			
79	7	4600*			
79	8	4550			
79	9	4500			
79	10	4400			
79	11	4300			

$$\text{MMD} = \frac{4600}{15} = 306 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{8000}{6} = 1333 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 27 June 1962

SPREAD FACTOR: 6.0

FLIGHT #: 5 ; Inwind

CONVERSION FACTOR: 2.5

SAMPLE LINE: C

PAPER: k omekote (Red)

FLOW RATE: 206 GPM

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
33	1	6300			
25	2	6100			
33	3	5500			
25	4	5300			
25	5	5200			
33	6	5000			
33	7	4500*			
33	8	4400			
33	9	4350			
33	10	4200			
33	11	4100			

$$\text{MMD} = \frac{4500}{15} = 300 \text{ microns}$$

$$\text{Max Sph Dia.} = \frac{6500}{6} \approx 1083 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 27 June 1962 SPREAD FACTOR: 6.0

FLIGHT #: 6 ; Crosswind CONVERSION FACTOR: 2.5

SAMPLE LINE: B PAPER: Kromekote (Red)

FLOW RATE: 206 GPM SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
7	1	7000			
7	2	6400			
7	3	5000			
7	4	4500*			
7	5	4300			
7	6	4100			
7	7	4000			
6	8	3900			

$$\text{MMD} = \frac{4500}{15} = 300 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{7000}{6} = 1166 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 1 July 1962 SPREAD FACTOR: 6.0

FLIGHT #: 3 ; Crosswind CONVERSION FACTOR: 2.5

SAMPLE LINE: B PAPER: Kromekote (Red)

FLOW RATE: 196 GPM SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
18	1	6600	20	16	4000
19	2	6000	19	17	3900
18	3	5900	19	18	3800
18	4	5700	19	19	3700
18	5	5400			
18	6	5300			
18	7	5200			
18	8	5100			
18	9	5000			
18	10	4900			
19	11	4700			
19	12	4400*			
19	13	4300			
19	14	4200			
20	15	4100			

MMD $= \frac{4400}{15} =$ 293 microns

Max. Sph. Dia $= \frac{6600}{6} =$ 1100 microns

Min. Sph. Dia $= \frac{150}{} =$ 25 microns

MASS MEDIAN DIAMETER

DATE: 3 July 1962

FLIGHT #: 2 ; Crosswind

SAMPLE LINE: C

FLOW RATE: 197

SPREAD FACTOR: 6.0

CONVERSION FACTOR: 2.5

PAPER: Kromekote (Red)

SPRAY MATERIAL: Purple

$$MMD = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
71	1	5600			
71	2	5500			
71	3	4800*			
71	4	4700			
71	5	4500			
71	6	4400			
71	7	4200			
71	8	4100			
71	9	4000			
71	10	3900			
71	11	3800			
71	12	3700			
71	13	3600			

$$MMD = \frac{4800}{15} = 320 \text{ microns}$$

$$\text{Max. Sph. Dia} = \frac{5600}{6} = 933 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 4 July 1962

SPREAD FACTOR: 6.0

FLIGHT #: 6 ; Crosswind

CONVERSION FACTOR: 2.5

SAMPLE LINE: C

PAPER: Kromekote (Red)

FLOW RATE: 194 GPM

SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
96	1	7200			
96	2	6600			
95	3	6000			
95	4	5800			
95	5	5700			
94	6	5600			
95	7	5400			
95	8	5300			
94	9	5000*			
94	10	4900			
94	11	4700			
94	12	4600			
94	13	4500			
94	14	4400			
94	15	4300			

$$\text{MMD} = \frac{5000}{15} = 333 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{7200}{6} = 1200 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 5 July 1962 SPREAD FACTOR: 6.0

FLIGHT #: 2 ; Inwind CONVERSION FACTOR: 2.5

SAMPLE LINE: D PAPER: Kromekote (Red)

FLOW RATE: 197 BPM SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-Max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
40	1	6000			
40	2	5900			
40	3	5800			
41	4	5600			
41	5	5500			
41	6	5300			
41	7	5200			
42	8	4700*			
41	9	4600			
41	10	4500			
41	11	4300			
41	12	4200			
41	13	4100			

$$\text{MMD} = \frac{4700}{15} = 313 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{6000}{6} = 1000 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 6 July 1962 SPREAD FACTOR: 6.0

FLIGHT #: 7 ; Crosswind CONVERSION FACTOR: 2.5

SAMPLE LINE: D PAPER: Kromekote (Red)

FLOW RATE: 179 GPM SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
23	1	7700			
23	2	6700			
23	3	6000			
23	4	5900			
23	5	5700			
24	6	5400			
24	7	4800*			
24	8	4500			
24	9	4500			
24	10	4400			
24	11	4200			
24	12	4100			
24	13	3900			

$$\text{MMD} = \frac{4800}{15} = 320 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{7700}{6} = 1283 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 6 July 1962 SPREAD FACTOR: 6.0

FLIGHT #: 8 ; Crosswind CONVERSION FACTOR: 2.5

SAMPLE LINE: D PAPER: Kromekote (Red)

FLOW RATE: 179 GPM SPRAY MATERIAL: Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
7	1	9300			
7	2	5800			
7	3	5300*			
7	4	5200			
7	5	5100			
7	6	5000			
7	7	4900			
7	8	4800			
7	9	4700			
7	10	4500			

$$\text{MMD} = \frac{5300}{15} = 353 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{9300}{6} = 1550 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{150}{6} = 25 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 10 July 1962 SPREAD FACTOR: 6.0

FLIGHT #: 5 ; Crosswind CONVERSION FACTOR: 2.5

SAMPLE LINE: B PAPER: Kromekote (Red)

FLOW RATE: 153 GPM SPRAY MATERIAL: 2 Fuel Oil, 1 Purple

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
4	1	3900			
2	2	3500			
3	3	3200*			
4	4	3100			
3	5	3000			
3	6	2900			
3	7	2800			
3	8	2700			
4	9	2600			
4	10	2500			
4	11	2400			
4	12	2300			
3	13	2200			
4	14	2100			

$$\text{MMD} = \frac{3200}{15} = 213 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{3900}{6} = 650 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 11 July 1962 SPREAD FACTOR: 6.0

FLIGHT #: 1 ; Crosswind CONVERSION FACTOR: 2.5

SAMPLE LINE: A PAPER: Kromekote (Red)

FLOW RATE: 150 GPM SPRAY MATERIAL: Fuel Oil

$$\text{MMD} = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
12	1	4200			
12	2	3200*			
9	3	3200			
9	4	3100			
9	5	3000			
10	6	2900			
11	7	2800			
11	8	2700			
11	9	2600			
11	10	2400			
11	11	2300			
10	12	2200			
10	13	2100			

$$\text{MMD} = \frac{3200}{15} = 213 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{4200}{6} = 700 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

MASS MEDIAN DIAMETER

DATE: 11 July 1962 SPREAD FACTOR: 6.0

FLIGHT #: 5 ; Crosswind CONVERSION FACTOR: 2.5

SAMPLE LINE: 150 GPM SPRAY MATERIAL: Fuel Oil

$$MMD = \frac{\text{Spot D-max}}{\text{Spread Factor x Conv. Factor}}$$

$$\text{Spherical Drop Size} = \frac{\text{Spot Dia.}}{\text{Spread Factor}}$$

Sta.	Drop #	Size	Sta.	Drop #	Size
7	1	3700			
5	2	3500			
5	3	3200*			
4	4	3100			
3	5	3000			
4	6	2900			
4	7	2800			
4	8	2700			
4	9	2600			
3	10	2500			
4	11	2400			
4	12	2300			
5	13	2100			

$$MMD = \frac{3200}{15} = 213 \text{ microns}$$

$$\text{Max. Sph. Dia.} = \frac{3700}{6} = 617 \text{ microns}$$

$$\text{Min. Sph. Dia.} = \frac{200}{6} = 33 \text{ microns}$$

Explanation of headings for the following table.

Date: Date this ground calibration test was conducted.

Test No: Sequence number of calibration test.

Solution Used: A = Pure Purple, B = 1 part purple + 2 parts fuel oil
C = Pure fuel oil.

Nozzle information:

Type used - Type used were spraying systems diaphragm check valve body, 6135 with either 1/4" pipe thread inlet or 3/8" pipe thread inlet.
Nozzle tips used - S.S. D-16 1/4" orifice solid stream.
S.S. Veejet U50070 Flat spray.
S.S. Veejet U50120 Flat spray.

Qty - quantity, total number of outlets open on both booms.

Location - Location of nozzles open on each boom, No. 1 is the first station on the inboard end of each boom.

ETS: Engine throttle setting, F = full, 3/4 or 1/2

PSI: Pressure at pump when spraying.

T : Time in seconds system was run.

VPG: Quantity in gallons of solution pumped.

Output GPM: Total gallons per minute dispersed by system.

GROUND FLOW RATE CALIBRATION INFORMATION

Date	Test No.	Sol Used	Nozzle Information: Type Used	Qty	Location	E T S	P S I	T	V P G	Output GPM	REMARKS
June 22	1	Water	1/4" 6135 Ck Valve, only	64	1-32 Ltr	F	27	30	111	222	Test of Purple Catchers
June 23	2	Purple	" "	64	" "	F	34	30	79	158	Engine closed during val closing.
" "	3	"	" "	84	1 thru 42	F	--	30	96	192	
" "	4	"	" "	82	1 thru 41	F	35	45	146	194.8	
" "	5	"	" "	82	" "	F	35	45	145	193.2	
" "	6	"	" "	78	1 thru 39	F	34	45	146.5	195.2	Nav diaphragms installed one missed on left side
" "	7	"	" "	74	1 thru 37	F	35	45	145.5	194	
" "	8	"	" "	70	1 thru 35	F	35	45	149	198.4	
" "	9	"	" "	70	" "	3/4	32	45	132.5	176.4	Throttle step set at abo 3/4 quadrant
" "	10	"	" "	70	" "	3/4	33	45	140	186.4	Test flown 24 June
June 24	11	"	" "	70	" "	3/4	32	45	136	181.2	Ck after spray runs
" "	12	2 Fuel Oil 1 Purple	" "	70	" "	3/4	26	30	81.5	163	2 parts fuel to 1 part p mixed.
" "	13	"	" "	70	" "	3/4	24	45	131	174.8	Material foamed in inboa drums
" "	14	"	" "	70	" "	3/4	24	45	136.8	182.0	Throttle opend about 1/1
" "	15	"	" "	70	" "	3/4	24	45	136.0	181.2	Flow per nozzle 2.55
June 25	16	"	Veejet U50070 nozzle tips added	70	" "	3/4	22	45	143.5	191.2	Nozzles produce flat spr
" "	17	"	" "	66	1 thru 33	3/4	22	45	132.0	176.0	
" "	18	"	" "	66	" "	3/4	22	30	95.5	191.0	30 sec. to stop foaming
" "	19	"	Veejet U50120 Nozzle tips added	66	" "	3/4	24	30	92.5	185.0	Nozzles produced flat sp
" "	20	"	3/8 6135 Ck Valve only	62	8 thru 38	F	27	30	109.5	219.0	Ck valves chatter
" "	21	"	" "	70	8 thru 42	F	28	30	109.5	219.0	
" "	22	"	" "	74	6 thru 42	F	28	30	113.5	227.0	
" "	23	"	" "	72	6 thru 41	F	27	30	112.5	225.0	
" "	24	"	" "	70	6 thru 40	F	27.5	30	112.5	225.0	Outer valves chatter
" "	25	"	" "	68	7 thru 40	F	27.5	30	110.5	221.0	" " "
" "	26	"	" "	68	" "	3/4	23	30	90.5	181.0	No chatter test flown 26
June 27	27	Purple	" "	66	" "	3/4	30	30	88.0	176.0	

te	Test No.	Sol Used	NOZZLE INFORMATION Type Used	QTy	Location	E T S	P S I	T	V P G	Out-Put GPM	REMARKS
n 26	28	Purple	3/8 6135 Ck Valve Only	70	6 thru 40	3/4	30	30	91.0	181.0	
"	29	"	" "	82	1 thru 41	3/4	29	30	89.5	179.0	This was less flow than test 28
"	30	"	" "	82	" "	F	32	30	102.5	205.0	
"	31	"	3/8" 6135 Ck val 1/4" 6135 " "	90	1 thru 41 1 thru 4	F	31	30	99.5	199.0	This was less flow than test 30
"	32	"	"	78	1-21,26-39, 1-4	F	32	30	103.0	206.0	
"	33	"	"	78	" "	F	32	30	101.5	203.0	
"	34	"	" "	74	1-21, 28-39, 1-4	F	32	30	103.0	206.0	Test flown 27 June
n 27	35	"	" "	74	1-7,10,13-21,29-40 1-4, 37-40	F	32.5	30	99.0	198.0	Test flown 1 July
l 1	36	"	" "	72	No. 10 closed	F	32			196est	Test flown 2 July
l 2	37	"	" "	72	1-7,13-15,19-21, 28-42. 1/4 1-4, 37-40	F	32	30	98.5	197	Test flown 3 July
"	38	"	" "	74	1-7, 13-15,19-22, 28-42, 1-7, 37-40	F	32	30	101.5	203.0	
3	39	"	" "	74	1-7,13-21,28-40, 1-4, 37-40	F	32	30	98.5	197.0	
3	40	"	" " ≠ D-16	72	1-7,13-21,29-40 1-4, 37-40 w/D-16 ¼" orifice	F	32	30	97.0	194.0	Test flown 4 July solid stream
4	41	"	" " ≠U50120	72	1-7,13-21,29-40 1-4, 37-40 w/50120	F	32	30	98.5	197.0	Test flown 5 July flat spray
9	42	"	3/8" 6135 Ck valves only	56	1-7,13-21,29-40	3/4	33	30	89.5	135 est 179.0	Test flown 6 July
"	43	"	"	52	1-7,13-20,30-40	1/2	30	30	76.0	152.0	
"	44	2 fuel oil 1 purple	"	52	1-7, 13-20,30-40	1/2	21	30	76.5	153.0	Teflon and new rubber diaphragms installed.Flown 10 J
10	45	fuel oil	"	52	1-7, 13-20, 30-40	1/2	12	30	75.0	150.0	Two runs, 148 & 152 GPM Flown 11 July.

APPENDIX F

SUPPORT

(SAMPLE)

C-123 SPRAY TEST PROJECT # 0071W

THURSDAY 5 JULY 1962

FRAG ORDER #008

TEST OBJECTIVE: Swath Width Determination and particle size (Ball park estimates for base line data of in flight equipment performance).

TEST SITE: Range 52 South.

SPECIFICATION: Equipment preset from static flow rate tests.

PUMP PRESSURE: (Throttle setting stop by Mr. Whittam.)

MATERIAL: Concentrate purple. (600 gallons enough for 8 passes at ________ gpm of 24 seconds each).

ALTITUDE: 150 feet.

AIRSPEED: 130 knots indicated.

WEATHER LIMITS: General inversion conditions, maximum wind 5mph, maximum temperature 79°, no precipitation.

SOLUTION #1: Swath Width. Direction of flight, In Wind, 4 to 6 passes 3 repetions.

SOLUTION #2: Particle Size Determination. Direction of flight, Cross Wind, 2 or more repetitions.

APG SUPPORT REQUIRED:

METRO: 1 observer to be in place at range 52-S at 0350 hours capable of providing temperature, dew point, wind speed, wind direction during test period at ground level; temperature, wind direction and velocity at 50', 100', 150' and 200' altitude. Of this information the wind direction at the altitudes is most important in order to select the most appropriate sample line. For the first run this information is required at least 10 minutes in advance (0420). Subsequently all met measurements will commence at the time of spraying for each run and be completed and available to the controller as soon as possible. The time period of obtaining the met information will also be recorded, for example, 0435 to 0440 hours.

COMMUNICATIONS: 1 Mobile air/ground communications unit to be in place at 0350 range 52-S. 4 Walkies Talkies radios.

TRANSPORTATION REQUIRED: 5 Jeeps w/drivers source Army personnel, will pick up personnel at quarters, provide transportation to mess hall, test site and return.

FILM PROCESSING: 3 rolls black and white 16 mm movies. (Gun cameras)

Flight crew and maintenance personnel will use assigned vehicles.

Aircraft #56-4362.

LOAD INFORMATION:	600 gallons concentrate loaded at Field #2, after static test completed on 4 July 1962
FERRY INFORMATION:	Return aircraft to Eglin Main after static test completed 4 July 1962. Aircraft will land at Field #2, after test mission completed on 5 July 1962 for further static testing.
DOSEMENT:	Mass median diameter particle size estimate of mass deposit. The results to be plotted on graph paper for analysis.
MISSION NUMBER:	5

COORDINATE SCHEDULE

FIELD CREW		FLIGHT CREW	
Wake Up	0230	Wake Up	0230
Transp Mess Hall	0245	Transp Mess Hall	0245
Breakfast	0250	Breakfast	0250
Transp to Range	0310	Transp to Range	0315
Set Up Range	0350	Take Off	0405
1st Run	0430	Dry Run	0420
Depart Range	0800	Live Run	0430
Arrive Test Ops	0845	Land at Field 2	0700

LABORATORY CREW

WORK SCHEDULE: 0700 to 1700 hours or as demanded.

SCHEDULE OF EVENTS: Daily.

Mass Deposit Flights.

1. Assay cards for deposit rate.
2. Tabulate data.
3. Graphical representation of data.
4. Ascertain swath width.
5. Calculate % of recovery of spray.

Mass Median Diameter Flights.

1. Determine 5 largest droplets having no more than 200 μ difference.
2. Select largest of the group and apply formula $mmd = \frac{D\text{-}max}{6.0 \times 2.5}$
3. Determine droplet size spectrum - largest to smallest droplet, measurable. Divide by S_f 6.0 to convert to spherical drop size.

Jeep Drivers and Truck.

1. All vehicles to have fuel and oil checks made on the day before an early morning departure.
2. The 1½ ton truck will be first to report to building 496 in the morning and from there it will depart to Test Ops, to load, then to mess hall.
3. The jeep will report to building 496 for pick up of personnel and then depart to mess hall.
4. Upon arriving at test area jeeps and crews working sample line will form to the rear of the 1½ ton truck for pick up of plates.
5. On completion of days tests the 1½ ton truck will depart to Test Ops, to unload equipment.
6. Jeeps will depart test area and proceed to Test Ops.
7. All vehicles needing washing will depart from Test Ops and proceed to the Base Motor Pool.
8. As soon as vehicles are washed, personnel will return to Test Ops.

PGOPW/MAJOR TUCKER/67-3704 11 JULY 1962

REVISED OPERATIONS DIRECTIVE 0071W, C-123 SPRAY TEST

ALL CONCERNED

1. THIS PROJECT HAS BEEN ACCEPTED AND APPROVED. REQUEST PLANNING AND IMPLEMENTATION ACTIONS BE TAKEN IN ACCORDANCE WITH THE CONTENTS OF THIS OPERATIONS DIRECTIVE. DUE TO LACK OF PRELIMINARY PLANNING DATA AND THE IMMINENT STARTING DATE, THE CONTENTS OF THIS OPERATIONS DIRECTIVE IS NOT CONSISTENT WITH INSTRUCTIONS CONTAINED IN CHAPTER 4 OF APGCM 25-1. SINCE THE SUPPORT REQUIREMENTS WERE IDENTIFIED AND COORDINATED AT A JOINT PLANNING MEETING ON 14 JUNE 1962, THE REQUIREMENTS OF SECTION III ARE ELIMINATED AND THE SUPPORT TO BE PROVIDED IS LISTED BY STAFF AGENCY AND FUNCTIONAL AREA IN SEPARATE PARAGRAPHS OF THIS DOCUMENT. THESE PARAGRAPHS WILL BE NUMBERED IN THE STANDARD OPERATIONS DIRECTIVE NUMBERING SYSTEM.

2. DUE TO INCREASED PROJECT SCOPE AND RESULTANT CHANGES OF APGC SUPPORT, THIS DOCUMENT REPLACES THE ORIGINAL OPERATIONS DIRECTIVE DATED 18 JUNE 1962.

/s/ BENTLEY HARRIS
COLONEL, USAF
CHIEF, PLANS & PROGRAMS DIVISION

PROJECT NR. 0071W TITLE: C-123 SPRAY TEST

SECTION I

PROJECT PLANNING GUIDANCE

1.0 GENERAL PROJECT INFORMATION

1. Authority: Hq USAF TWX AFOOP-CO 94626, dated 6 June 1962.

2. Responsible Agency: ARPA

3. Participating Agencies and Responsibilities:

a. US Army Chemical Center is the ARPA Executive Agent and will conduct the test.

b. APGC will provide the test site and test support.

c. TAC will provide aircraft.

d. ASD, Detachment 4, and SAWC will monitor the test.

4. Priority: APGC ID. This project is listed in the Special Emphasis Projects Section of the APGC Program Summary.

5. Security: Test results are classified OFFICIAL USE ONLY.

1.1 PURPOSE AND OBJECTIVES

1. Purpose: To conduct a C-123 Spray Test.

2. Objectives:

a. To determine droplet size.

b. To determine swath width.

c. To determine mass deposit/acre.

d. To conduce TAC crew training.

1.2 SPECIAL PLANNING FACTORS:

1. TAC WILL PROVIDE 4 C-123 AIRCRAFT, FLIGHT AND MAINTENANCE CREWS, AND AIRCRAFT PARTS OTHER THAN COMMON BENCH AND SHOP STOCK. TWO AIRCRAFT WILL BE INSTRUMENTED BY MAAMA AND WILL BE THE PRIMARY TEST AIRCRAFT, WHILE THE ADDITIONAL TWO WILL BE USED FOR CREW TRAINING. APPROXIMATELY 100 HOURS OF TRAINING AND 18-36 TEST SORTIES WILL BE FLOWN.

2. 4900 GALLONS OF 2,4D AND 2,4,5T IN 50 GALLON DRUMS WILL ARRIVE ABOUT 20 JUNE 1962 IDENTIFIED FOR THIS TEST.

3. LABORATORY SPACE, APPROXIMATELY 25x25 FEET WITH BENCH SPACE AND WATER WILL BE REQUIRED.

4. TAC WILL PROVIDE SUPPLY SPECIALIST.

5. A METERING TEST WILL BE REQUIRED AND MUST BE ACCOMPLISHED AT A LOCATION OTHER THAN THE MAIN BASE DUE TO LASTING KILLING EFFECTS ON PLANT LIFE BY THE TEST AGENT. FIELD #2 WILL BE USED FOR THIS TEST.

6. CHEMICAL CORPS PERSONNEL WILL BEGIN ARRIVING ON 18 JUNE, TAC PERSONNEL AND AIRCRAFT ON 19 JUNE.

7. TEST WILL BE CONDUCTED EARLY IN THE MORNING AND LATE IN THE EVENING. HIGH HUMIDITY (TEMPERATURES ABOVE 80°F) AND WINDS ABOVE 5 MPH ARE CONTROLLING METEOROLOGICAL FACTORS FOR IN-WIND FLIGHTS, 8-10 MPH FOR X-WIND FLIGHTS.

8. THE CHEMICAL CORPS WILL PROVIDE SIX JEEPS, DRIVERS. APGC WILL PROVIDE NORMAL SUPPORT FOR THESE VEHICLES.

1.3 DESCRIPTION OF PROJECT

AFLC WILL MODIFY TWO (2) C-123 AIRCRAFT TO PROVIDE A SPRAY CAPABILITY. TREATED PANELS WILL BE PLACED ON A CLEARED TEST AREA AT A SPECIFIED DISTANCE ABOVE THE GROUND, AND SPRAYING PASSES OVER THESE WILL BE MADE BY THE C-123'S. THE PANELS WILL BE PICKED UP AFTER EACH PASS, AND RETURNED TO EGLIN MAIN FOR EVALUATION.

1.4 SCHEDULE

1. TEST WILL BEGIN WHEN AGENT ARRIVES, ON OR ABOUT 20 JUNE 1962.

2. ESTIMATED COMPLETION DATE IS 30 AUGUST 1962.

3. CHEMICAL CORPS PERSONNEL WILL BEGIN ARRIVING ON 18 JUNE.

4. TAC AIRCRAFT AND PERSONNEL WILL BEGIN ARRIVING ON 19 JUNE.

5. CHEMICAL CORPS MUST SUBMIT A PROGRESS REPORT TO ARPA ON 15 JULY.

1.5 KEY PERSONNEL

PLANS	MAJOR L.C.TUCKER,PGOPW,EXT 67-3704
TEST DESIGN	MR. FITZGERALD,PGWT, EXT 67-3132
TEST PROJECT	CAPT WEAVER, PGWM, EXT 67-3400
TECHNICAL FACILITIES	MR. CLAUSEN, PGVP, EXT 67-3061
MATERIEL	MR. DIETRICK, PGM, EXT 67-2008
MAINTENANCE	CAPT ALBRITTON,PGBM,EXT 67-3156
CHEMICAL CORPS	LT COL THOMPSON
CHEMICAL CORPS	DR. J. W. BROWN
TAC	CAPT CARLSON, CAPT ROBINSON

SECTION II

CONCEPT OF OPERATIONS

2.1 METHOD OF ACCOMPLISHING PROJECT OBJECTIVES.

THE SPRAY WILL BE MIXED AND LOADED IN A DESIGNATED RAMP AREA. AFTER EACH PASS BY THE SPRAY AIRCRAFT, OVER THE COLLECTION TARGETS, THEY WILL BE RETURNED TO THE LABORATORY FOR ASSESSMENT BY CHEMICAL CORPS PERSONNEL.

2.2 PROJECT MISSION SCHEDULE.

OBJECTIVES 2.A., 2.B., 2.C., WILL BE ACCOMPLISHED SIMULTANEOUSLY ON EACH MISSION. THE TAC CREW TRAINING MISSIONS WILL BE SCHEDULED ON AVAILABLE TEST AREAS BY THE PROJECT COORDINATOR.

PROJECT NR. 0071W TITLE: C-123 SPRAY TEST

1. TEST MISSIONS:

A.	MISSION NUMBER	1-150
B.	AIRCRAFT	C-123 (TAC)
C.	TEST AREA	52 SOUTH
D.	ALTITUDE	150 FEET
E.	AIRSPEED	130 KIAS

THESE MISSIONS WILL BE SCHEDULED THROUGH PGOO BY THE PROJECT COORDINATOR IAW STANDARD PROCEDURES.

2.3 REPORTS

1. THE CHEMICAL CORPS WILL PREPARE ALL TECHNICAL REPORTS.

2. PGW WILL PREPARE REQUIRED PROGRESS AND TERMINATION REPORTS.

SECTION IV

SUPPORT SOLUTIONS

4.0.1 DATA

1. TEST AREA 52 SOUTH HAS BEEN SELECTED FOR THIS TEST. TO PROVIDE AN ADEQUATE SAMPLE GRID A 1000' RADIUS CIRCLE AREA WILL BE CLEARED. EIGHT LINES IN AN OCTAGON PATTERN WILL BE ESTABLISHED IN THE AREA BY SURVEY CREWS TO 3D ORDER ACCURACY, LINES WILL BE 2000' LONG AND STAKED AT 20' INTERVALS, SURVEY WILL BE ACCOMPLISHED BY CREWS PROVIDED BY THE 3208TH TEST GROUP. TO AID PILOT IN IDENTIFICATION OF TARGET SIXTEEN (16) LINES WILL BE ESTABLISHED BY SURVEY AND CHOPPED APPROXIMATELY 16 FT WIDE FOR A DISTANCE OF TWO THOUSAND (2000) FEET FROM THE OUTSIDE PERIMETER OF PRESENT TEST AREA. THE U. S. ARMY CHEMICAL CORPS WILL PROVIDE:

A. 800 2"x2"x4' STAKES, SAMPLING BOARDS AND INSTALL SAME IN TEST AREA.

B. PERSONNEL AND VEHICLES (6 JEEPS) FOR DISTRIBUTION AND COLLECTION OF ALL SAMPLES COLLECTED TO COMPLETE THIS TEST.

4.0.2 DATA REDUCTION

ALL DATA COLLECTED WILL BE REDUCED BY PERSONNEL FROM U.S. ARMY CHEMICAL CORPS.

4.0.3 PHOTO

THE PHOTOGRAPHIC LABORATORY WILL PROVIDE PROCESSING OF ALL FILM EXPOSED DURING TEST. IN ADDITION TO CERTAIN FILM PROVIDED BY U.S. ARMY CHEMICAL CORPS, PGVF WILL PROVIDE:

A. APPROXIMATELY 300 EACH MAGAZINE 50' 16MM TRIX B&W FILM.

B. RAPID PROCESSING OF FILM UPON REQUEST OF PROJECT OFFICER.

C. 400 2"x2" SLIDES FROM FILM SELECTED BY TEST TEAM.

4.0.9 OTHER SPECIAL TECHNICAL SERVICES

THE 3208TH WILL PROVIDE THE MOBILE COMMUNICATIONS AND TWO WALKIE-TALKIE RADIOS REQUIRED BY GROUND CREWS PRIOR TO AND DURING TEST MISSIONS. PREPARE TEST AREA LAYOUTS AND NECESSARY WORK ORDERS FOR CLEARING AND CHOPPING OF TEST AREAS.

4.1.1 FORECASTS AND OBSERVATIONS

PGGW WILL FURNISH THE COMMANDER OF THE TEST TEAM A WEATHER OBSERVER UNIT TO MAKE ACCURATE AND TIMELY OBSERVATIONS OF:

A. SURFACE WIND, TEMPERATURE AND HUMIDITY.

B. WIND DIRECTION, VELOCITY, TEMPERATURE AND HUMIDITY AT 50, 100, 150, AND 200 FT ALTITUDES.

THE PURCHASE OF A HOT WIRE ANEMOMETER IS AUTHORIZED TO GIVE PGGW THE WIND VELOCITY DETERMINATION CAPABILITY.

4.2.1 COMMUNICATIONS:

TELEPHONE AT SITE H AND AT ADMINISTRATIVE SPACE IN BUILDING 103 WILL BE PROVIDED BY PGMC AFTER SUBMISSION OF WORKORDER REQUESTS BY THE PROJECT COORDINATOR.

4.2.3 ADMINISTRATIVE FACILITIES:

ADMINISTRATIVE AND WORKSPACE WILL BE PROVIDED IN BUILDING 103, TEST OPERATIONS. AIRCRAFT PARKING AREA WILL BE SITE H, AND TWO TENTS, APPROXIMATELY 14'x14' WILL BE ISSUED BY PGBHS. THESE WILL BE USED TO STORE PROJECT MATERIAL AND WILL BE UTILIZED AS A SITE OPERATIONS FACILITY. SECRETARIAL ASSISTANCE WILL BE PROVIDED BY PGOP. SECRETARIAL SUPPLIES WILL BE PROVIDED BY PGW.

4.2.4 TECHNICAL FACILITIES

1. FLOOD LIGHTS WILL BE PROVIDED BY PGBUE. PROJECT COORDINATOR WILL CONTACT MR. PIERCE, 67-3653, FOR INSTALLATION.

2. TWO CALCULATORS, MONROE OR EQUAL, WILL BE PROVIDED BY HQ SQUADRON, PGBHS.

4.2.7 SUPPLIES AND EQUIPMENT

SUFFICIENT MATERIAL AND SERVICES WILL BE PROVIDED TO CONSTRUCT THE COLLECTION APPARATUS REQUIRED FOR THE STATIC FLOW CALIBRATIONS CONDUCTED AT FLD #2.

4.2.9 AEROSPACE GROUND EQUIPMENT MAINTENANCE:

MAINTENANCE OF THE C-123 AIRCRAFT WILL BE PROVIDED BY THE TAC CREWS ACCOMPANYING THE AIRCRAFT. APGC WILL PROVIDE ALL NORMAL TRANSIENT MAINTENANCE AND FIELD MAINTENANCE SUPPORT. SPARES FOR SUPPORT OF THE C-123 AIRCRAFT WILL BE PROVIDED BY TAC, UTILIZING A PURGED FLY-AWAY KIT. SPARE REQUIREMENTS OVER AND ABOVE THOSE CONTAINED IN THE FLY-AWAY KIT WILL BE OBTAINED FROM AFB 2823 UTILIZING NORMAL PROCEDURES FOR SUPPORT OF TRANSIENT AIRCRAFT. OTHER SPARES WILL BE OBTAINED BY TAC, AND REPLENISHMENT OF THE FLY-AWAY KIT IS THE RESPONSIBILITY OF TAC.

4.2.10 VEHICLE, MATERIEL HANDLING & AEROSPACE GROUND EQUIPMENT:

Two (2) 1½ ton trucks, one with covered body, two (2) 3/4 ton pickups, and one station wagon will be furnished by APGC Motor Transportation Officer. Normal maintenance support of the six jeeps to be furnished by the Army Chemical Corps will be provided by APGC.

4.2.12 PROPELLANTS, FUELS, LUBRICANTS, GASES, AND CHEMICALS

Number 2 grade fuel oil will be furnished by PGBSP, Fuels and Petroleum Section. The project coordinator will furnish M/Sgt DeSotel, 67-3555, the quantity, time and place of delivery one day in advance of actual requirement.

4.5.1 RANGE SAFETY PROCEDURES

1. Aircraft will not be flown over populated areas when carrying test items.

2. Project Officer will provide pilot with an approved flight path to and from the range avoiding all populated areas.

1. APGC OPERATIONS DIRECTIVE NO.	2. PROJECT TITLE:			
0071W	C-123 SPRAY TEST			
3. PAGE TITLE: METHOD OF ACCOMPLISHING PROJECT OBJECTIVES	4. REPLACES PAGE(S) NO:	DATED:	5. DATE: 11 JUNE 62	6. PAGE NO. 2.1.1

11. REMARKS:

TARGET IS A CLEARED AREA APPROX 2000' x 2000'.

AIRCRAFT WILL BE C-123 TYPE. FLYING AT 150' ALTITUDE AND 130 KIAS.

MISSIONS WILL BE FLOWN WITH MAX SURFACE WIND OF 4 KTS, AND A/C WILL BE SCHEDULED TO ARRIVE ON RANGE AT DAY BREAK.

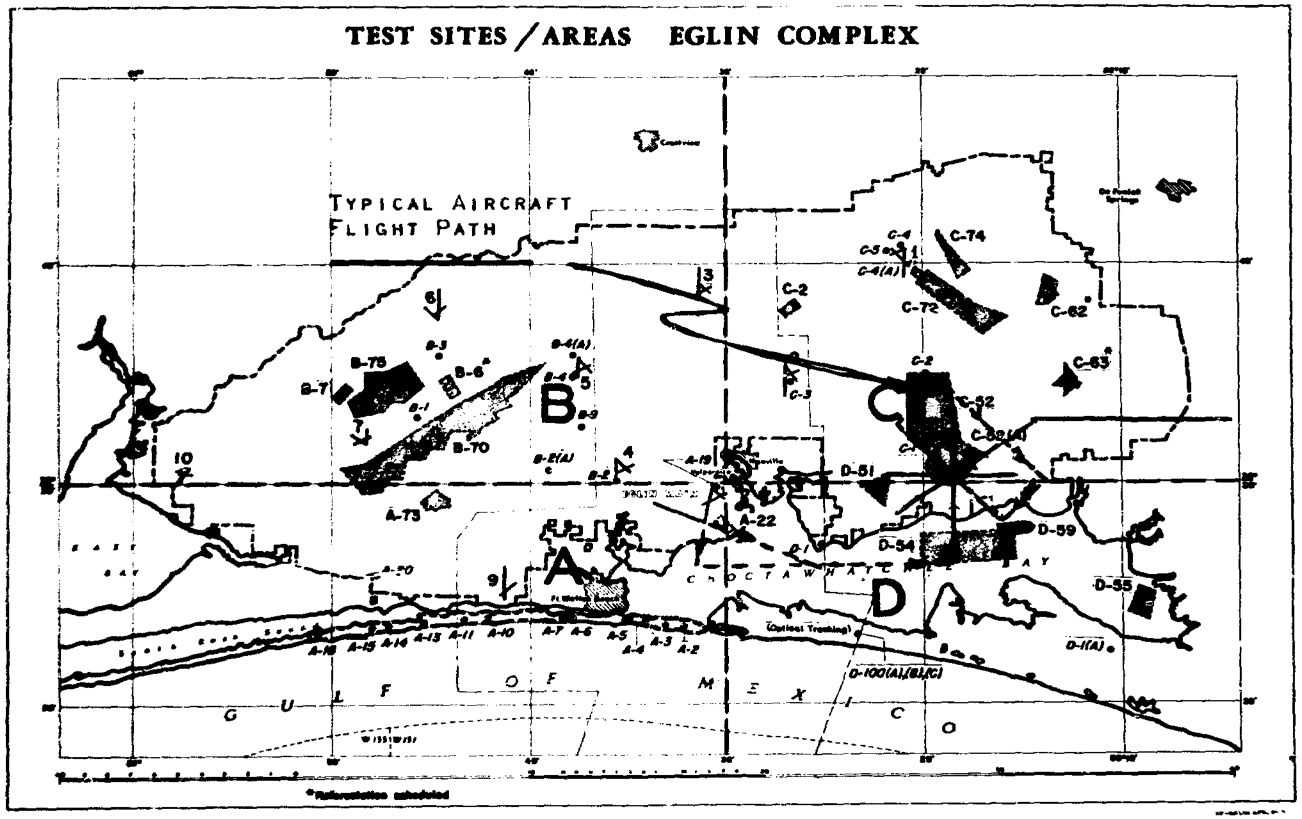
AIRCRAFT FLIGHT HEADING WILL VARY WITH THE PREVAILING WIND AS DETERMINED ON THE DAY OF EACH MISSION.

AIRCRAFT WILL AVOID FLIGHT OVER POPULATED AREAS.

Approved:
R.P. Weir
Capt. USAF

Ralph W. Weaver Jr

RALPH W. WEAVER, JR., CAPT, USAF
CHIEF, BOMBS & FUZES DIVISION
DIRECTORATE OF MUNITIONS TEST



8. VALIDATED BY:	9. APPROVED BY:	10. DISTRIBUTION:

APGC FORM DEC 61 111a

LAND RANGE PROFILE

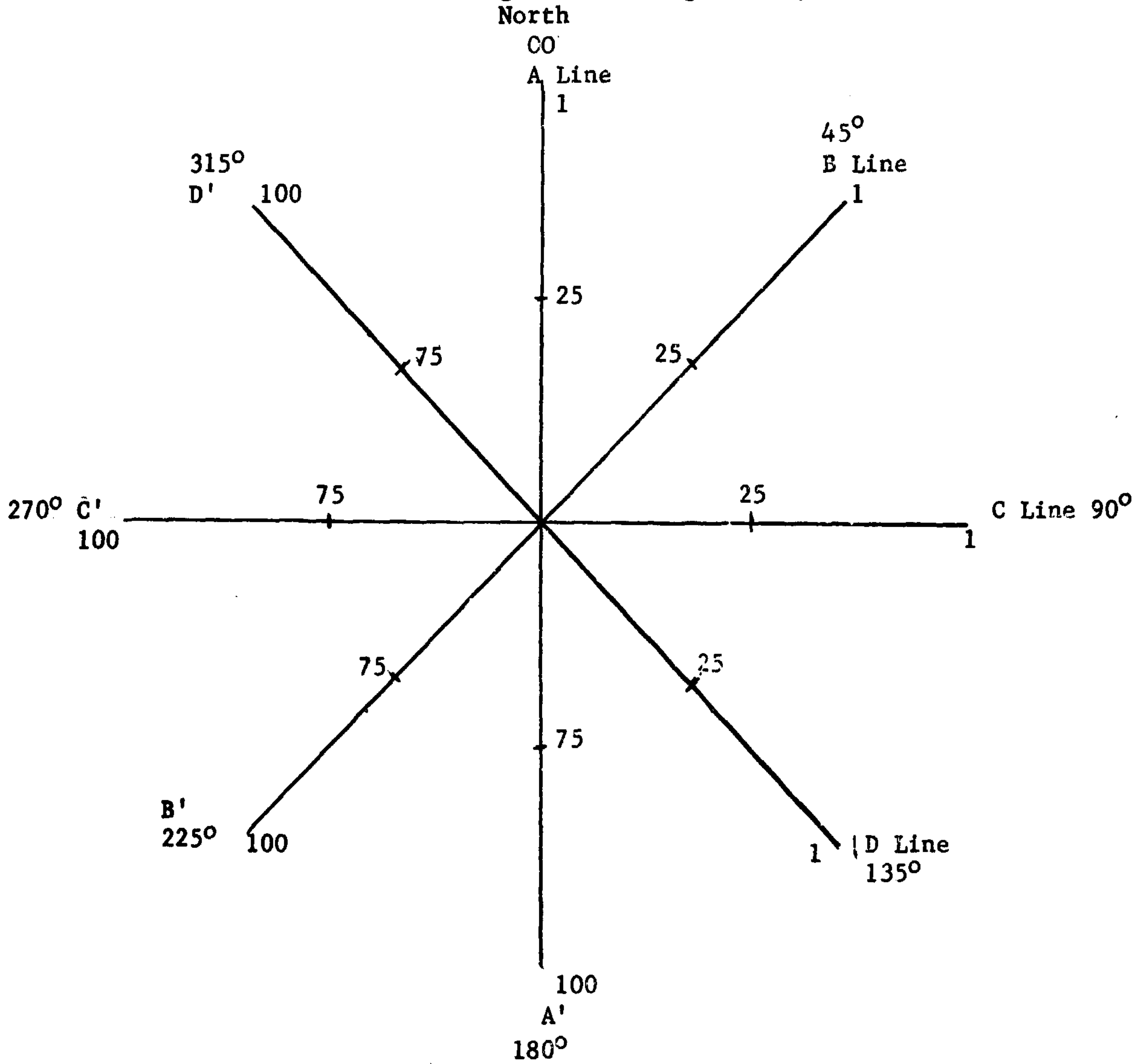
AF-EGLIN AFB, FLA

APPENDIX G

SAMPLE WORK FORM

GRID DIAGRAM

C-123 SPRAY TEST   Range 52 S   Eglin AFB, Fla.



Material: ________

Date: ________

Flight #______; ______

Sample line: ________

Altitude: ________ feet

Aircraft Course ________ degrees

Sta. Aircraft Course ________

Time of Release ________ hours

Duration: ________ seconds

Weather conditions

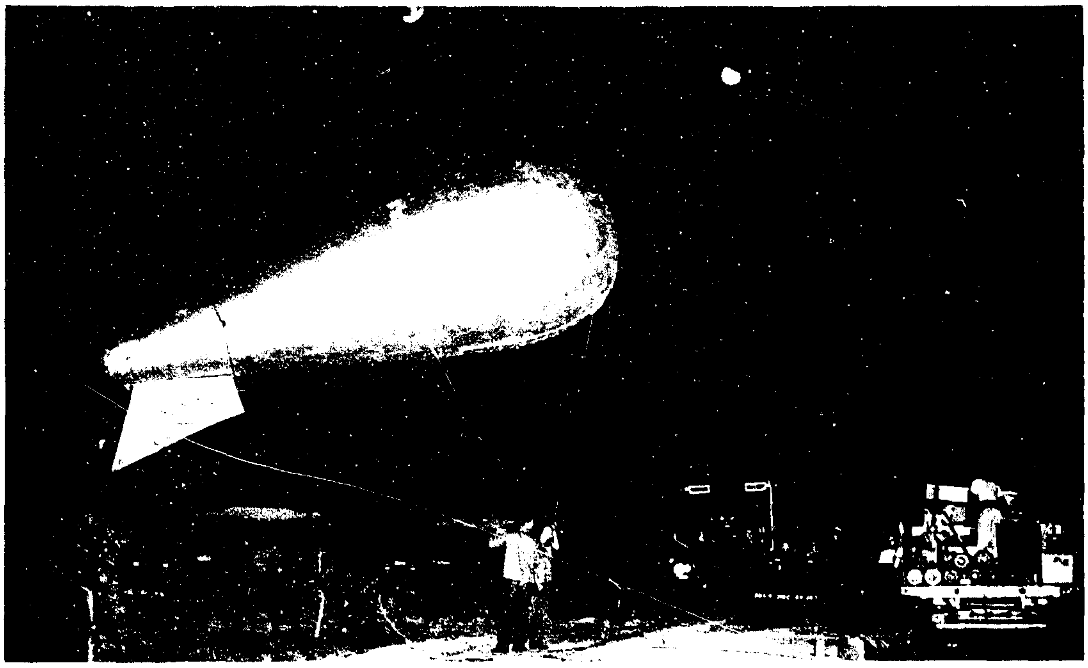
Time	Wind Direction Degrees	Wind Velocity (mph)	Temp (°C)	Dew Point (°C)
Ground				
50 Ft				
100 Ft				
150 Ft				
200 Ft				

Remarks: ____

____

APPENDIX H

PHOTOGRAPHS



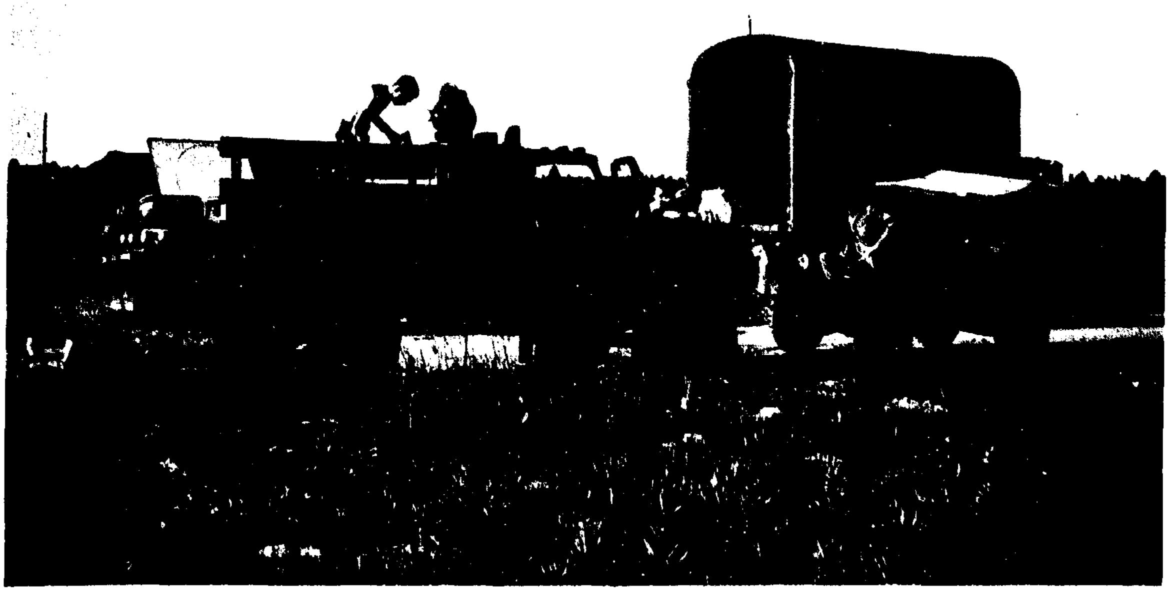


Fig. 1: Meteorological section operating on site.

Fig. 2: Servicing the sample line.

Fig. 3: Sample line station.

Fig. 4: Spray flight.

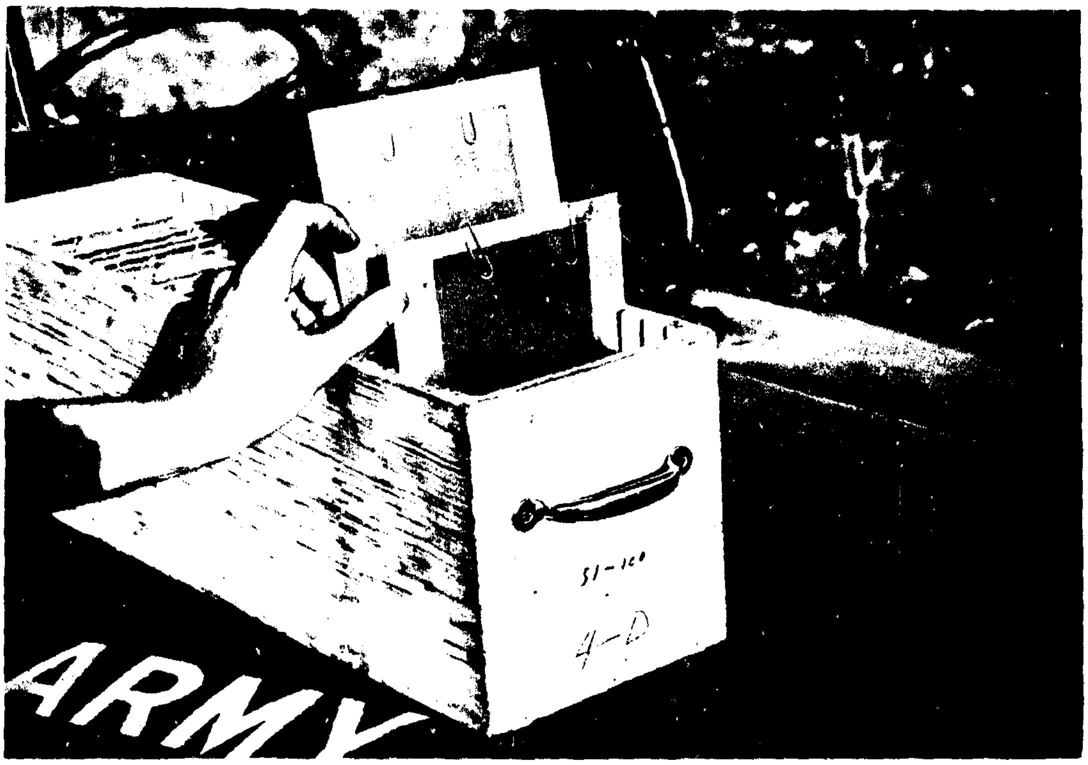


Fig. 5: Collected cards after exposure to spray.

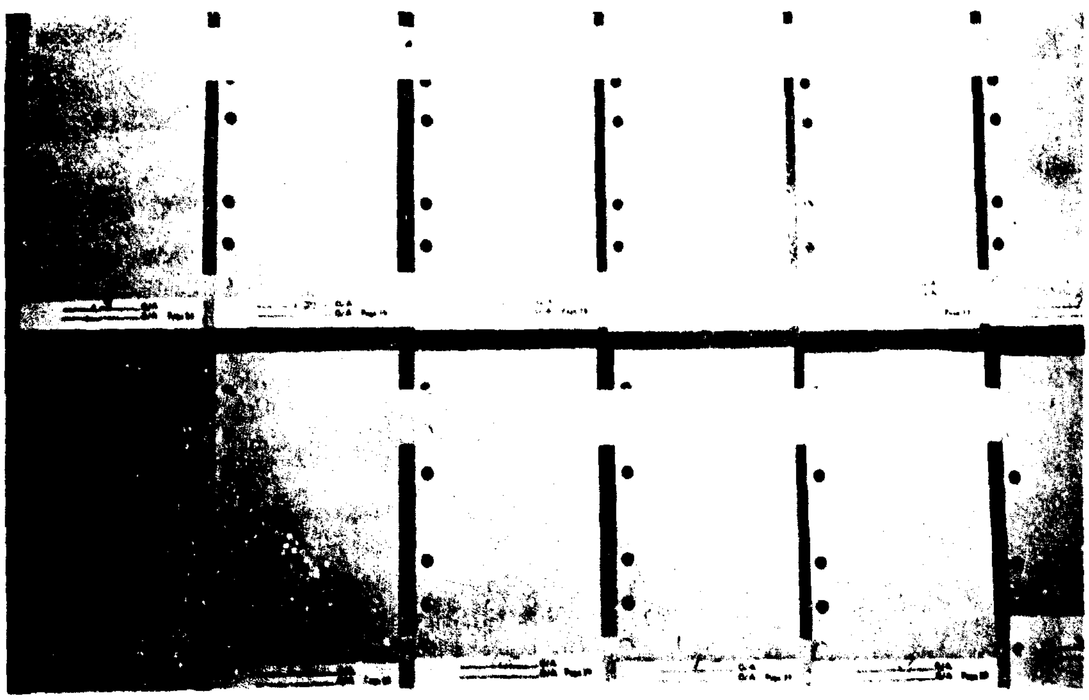


Fig. 6: "Standards" for comparison (supplied by USDA).

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* U.S. Air Force, U.S. Department of Agriculture, and U.S. Army (Cml Corp)	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP Not applicable

3. REPORT TITLE
Modification and Calibration of Defoliation Equipment
(C-123 - First Modification)

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5. AUTHOR(S) *(Last name, first name, initial)*
Brown, James W.
Whittam, Donald

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
July 1962	82	20

8a. CONTRACT OR GRANT NO. b. PROJECT NO. OSD/ARPA Order 256-62, Amendment 4 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

10. AVAILABILITY/LIMITATION NOTICES Each transmittal of this document outside the agencies of the U.S. government must have prior approval of the Director of Technical Information, Advanced Research Projects Agency, Office of the Secretary of Defense.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Advanced Research Projects Agency, Office of the Secretary of Defense

13. ABSTRACT

This report describes work undertaken to modify and calibrate the MC-1 Defoliant Spray System for use with C-123 aircraft. Data are presented on tests undertaken to determine such things as nozzle placement, and numbers and kinds of nozzles compatible with appropriate pressures for proper nozzle performance. Under all objections of the investigations were the employment of aim ability and effective deposition of a defoliant spray with a minimization of drift. Seven supporting appendices are included.

DD FORM 1 JAN 64 1473

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

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1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

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13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS)*, *(S)*, *(C)*, or *(U)*.

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